

The AMSAT[®] Journal

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Phase 3D launch agreement with Ariane has been signed! From left to right, Peter Guezlow, DB2OS, C. Bardou, B. Eilertson (Arianespace) and AMSAT-DL President and Phase 3D Project Leader, Karl Meinzer, DJ4ZC in Marlburg, Germany for the signing of the Phase 3D launch agreement. See page 5 for additional details. (AMSAT-DL photo)

17th AMSAT Annual Meeting and Space Symposium a Success in San Diego!

Bruce Paige, KK5DO (kk5do@amsat.org)

It was a nice cool day with sunny skies in San Diego when participants of the 17th AMSAT Annual Meeting and Space Symposium descended from all directions on the Hanalei Hotel. Standing on the steps to the meeting rooms was a group of Amateur Radio satellite operators. But where were their radios and what were they looking at as they gazed to the heavens? Ah....a pass of Starshine, the disco ball in the sky.

[continued on page 4]

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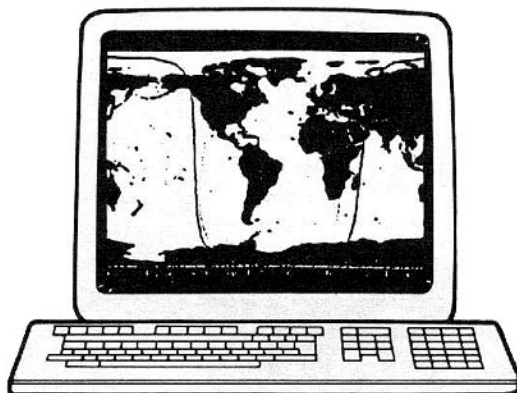
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AMSAT-NA can take your order for a Kansas City Tracker/Tuner or one of many Satellite Tracking software packages that support the KCT, such as Quiktrak, Graftrak, and WiSP for Windows. When you order thru them, they receive a Donation in your name towards the Phase 3D Project. Their telephone number is 301-589-6062.



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and efforts to produce The AMSAT Journal.

Apogee View

Your Help is *STILL* Needed

By now, I am sure you have heard the good news that our Phase 3D satellite has been accepted as a secondary payload aboard an Ariane 5 launch vehicle now slated for launch sometime in 2000. A contract defining the details of the launch has been signed by officials of Arianespace and the Phase 3D Project Leader and AMSAT-DL President, Dr. Karl Meinzer, DJ4ZC. The spacecraft is complete and has undergone rigorous thermal vacuum and vibration testing. As this editorial is being written, Phase 3D is being prepared for shipment from the Orlando Lab to Kourou, French Guiana to await launch.

Just when that launch will occur depends on Arianespace matching our spacecraft with an appropriate primary payload. However, rest assured, Arianespace would not have signed our contract if they did not fully intend to give us a ride. So, all we can do now is wait patiently and prepare for the new era in Amateur Radio that Phase 3D will usher in.

Well, not quite. There *is* something else you can do. Please let me explain.

Although many of you have contributed handsomely since the inception of the Phase 3D project, our expenses have also been substantial. Contributions to AMSAT-NA, in support of its commitments to the project, have been in the order of \$1.5 Million. That includes over one half million dollars from ARRL and significant amounts received from AMSAT-DL, AMSAT-UK, JAMSAT and others. Nevertheless, the Project has taken longer than any of us had planned. Most of you have closely followed the progress of the satellite from its conceptual design through its final checkout. Without going into all the many and varied details, suffice it to say that numerous (and often unanticipated) delays in the project schedule have caused significantly higher than expected expenses.

As a result, through the end of 1999, we project AMSAT-NA will have expended approximately *three hundred thousand dollars* more than we have raised for the Phase 3D project. Unfortunately, we now anticipate there will be even *more* needed outlays in connection with Phase 3D for which we are still responsible. Specifically, we must send qualified people to Kourou and keep them there long enough to perform the many pre-launch tasks necessary to get the spacecraft ready to be mounted on the launch vehicle. These include such activities as the exacting job of installing the solar panels and the very tricky and hazardous process of fueling the spacecraft prior to flight. Our estimate is that this launch campaign will entail an additional expenditure of possibly as much as *fifty thousand dollars*. The cost just to ship the spacecraft to Kourou is expected to be nearly

\$20,000! Unless more money can be raised between now and then, these additional outlays for Phase 3D will seriously curtail our ability to provide critical seed money for future projects as well as threaten AMSAT-NA's ability to carry on as a viable organization.

While we still need to complete Phase 3D, we have also now incurred major commitments to support the amateur radio station which is to be aboard the International Space Station (ISS). Unfortunately, one can't just go buy a transceiver from a local ham store and expect to put it on a Shuttle for installation on ISS. The equipment will have to meet rigorous space standards as well as be tailor made for use on ISS. Amateur satellite organizations in many countries are participating in this exciting endeavor, but AMSAT-NA is one of the principal ones supplying equipment and having it checked out and prepared for transport. Currently, we estimate this effort will require possibly another *fifty thousand dollars*.

So, if you add our ongoing Phase 3D commitments to those now associated with ISS you can immediately see why I am asking you, once again, to "answer the call". However, now, more than ever, your help is *urgently* needed if AMSAT-NA is to complete its commitments to Phase 3D as well as continue its leadership role as the principal North American amateur radio satellite organization still building space hardware.

By now, each of you should have received a letter from us containing a contribution form. I know this is a busy time of year for many of us, and things can get "buried" under a stack of other things in a hurry. However, right now, while you are thinking about it (and if you haven't done so already), please take a few moments to locate my letter, clip off the contribution form, fill it out, and then return it to us with your donation. Please contribute as much as you possibly can. All contributions, large or small, will be gratefully acknowledged for income tax purposes.

And now, for a limited time, those of you who answer our urgent call for financial help will receive a colorful commemorative decal showing the AMSAT logo along with the words "Keeping Amateur Radio in Space". The design has been specially commissioned for this fund raising campaign and will allow you to show others that you are *firmly* committed to AMSAT's goals in space.

Once again, my personal thanks to all of you for your continued, strong support! I'm confident that, together, we can, and *will* keep a fiscally strong AMSAT designing, building and launching space hardware well into the next century.

Keith Baker, KB1SF ■

[continued from page 1]

You should have just seen the excitement as we stared into the heavens while passersby wondered what were all these people doing? Was the Earth coming to an end? No, it was simply the kickoff of another AMSAT symposium. Inside, the seminars had begun and with 200 attendees registered, it was a larger crowd than last year. Also represented were international participants from 13 countries including Canada, New Zealand, Indonesia, Japan, Venezuela, Spain, Germany, England, France, Australia, South Africa, and Slovenia.

Kicking off the opening ceremonies was an announcement from AMSAT-NA President Keith Baker, KB1SF, who reported that a contract was just signed with Arianespace to fly Phase 3D on an Ariane 5 launch. The room rumbled in excitement over this news and it was a great way to start the day!

The presentations that followed were:

- *The Apogee at Constant Time-of-Day Equatorial (ACE) Orbit for Amateur Radio Satellites*, by Ken Ernandes, N2WWD
- *Converting Surplus Qualcomm OmniTRACS Microwave Assemblies for Use with Amateur Satellites*, by Kerry Banke, N6IZW
- *OPAL: A First Generation Microsatellite That Provides Picosat Communications for the Amateur Ra-*

dio Community, by Bob Twiggs, KE6QMD, James Cutler, Greg Hutchinson, and Jeff Williams

- *Why AMSAT Software Should be Free Software*, by Bdale Garbee, N3EUA
- *ASUSat1: On Orbit Operations and Satellite Profile*, by Assi Freedman, KK7KX, Brian Underhill, and Helen Reed
- *New ASUSat Projects for Fall 1999: Three Corner Sat and Distributed Ground Station Network*, by Assi Friedman, KK7KX, Joye Wong, and Helen Reed
- *Using Point-to-Point Protocol (PPP) for Satellite Communication*, by Andrew Taylor, KC0BPD
- *435-438 MHz Patch Antenna*, by Cliff Buttschardt, K7RR
- *JAWSAT Overview*, by Randy Kohlwey, N7SFI
- *InstantTune and the Yaesu FT847*, by Anthony Monteiro, AA2TX
- *Anatomy of a SETI Hoax*, by Paul Shuch, N6TX

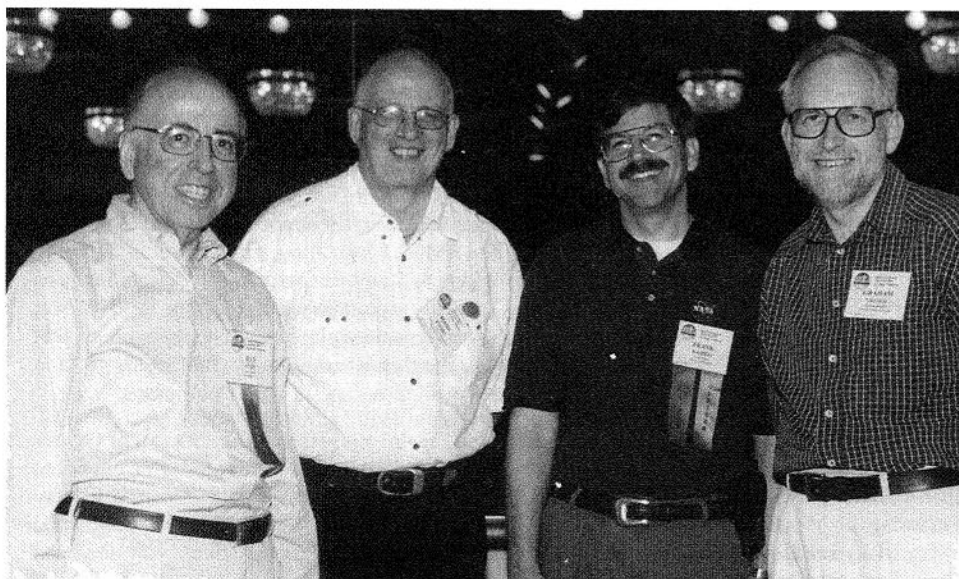
And this represents only the seminars on Friday. When Saturday rolled around, many more excellent subjects were covered. They were:

- *Detroit Area Satellite Gateway*, by Jerry Smyth, K8SAT
- *Emerald: A First Generation Microsatellite That Provides Picosat Communications for the Amateur Community*, by Bob Twiggs, KE6QMD and Freddy Pranajaya
- *Amateur Satellites - A Resource for Emergency Communications*, by Bill Burden, WB1BRE
- *No-Tune Transceivers for 1296, 2304 & 5760 MHz*, by Matjaz Vidmar, S53MV
- *No-Tune SSB/CW Transceiver for 10 GHz*, Matjaz Vidmar, S53MV
- *AMSAT Builders Channels for HT and Mobile Satellite Communications*, by Bob Bruninga, WB4APR
- *SUNSAT (SO-35) Update*, by Hans Van De Groenendaal, ZS5AKV
- *Small Satellite Applications of the CAN Bus*, by Bdale Garbee, N3EUA and John Conner, WD0FHG
- *Amateur Radio On-Board the International Space Station*, by Frank Bauer, KA3HDO and Will Marchant, KC6ROL
- *Phase 3D Update*, by Keith Baker, KB1SF and others

Now, if you didn't think that was enough to keep you on the edge of your seat for two days, there was a Special Event Station, WB6LLO, set up for Amateur Radio satellite operation by Dave Guimont, WB6LLO and Steve Wilmet, WB6BDY. Throughout the symposium, contacts were made on many satellites.

While all the talks were going on, Bruce Paige, KK5DO, that's me, was busy keeping a satellite link fed with the live audio. As well as doing that, all the seminars were being digitally recorded in RealAudio[®] format and later uploaded to the Internet for those not able to attend the symposium. You can find the audio clips at <http://www.amsatnet.com>.

As has been done in past years, Dave (WB6LLO) and Leanore (KA6UCD) Guimont provided the symposium attendees with a bit of a challenge with their annual jewelry contest. Dave had constructed a *PenTenna*, an antenna made from two pens



Sharing a visit at the symposium (l to r) are AMSAT VP for International Affairs, Ray Soifer, W2RS; SO-35 fame Hans Van De Groenendaal, ZS5AKV; AMSAT VP for Human Space Flight, Frank Bauer, KA3HDO; and Satellite Frequency Coordinator, Graham Ratcliff, VK5AGR. (Photo

angled in a VEE orientation. Dave actually made radio contacts with the antenna so it did work. Now, for the challenge; what frequency was the antenna tuned for? It was 435.8521739 MHz. Eddie Pettis, N5JGK had the closest guess at 435.855 MHz (a favorite FO-20 frequency?) and took home the *PenTenna*. Runners up were Duane Naugle, KO6BT, and Anthony Monteiro, AA2TX.

After all was said and done on Saturday, participants adjourned to poolside to enjoy some camaraderie and liquid refreshments during the famous *Thruster Firing* hour. When the Saturday evening banquet started, there were plenty of brisket, new potatoes, carrots and broccoli. All this was preceded by a salad and rolls. The desert was cheese cake and then came the Guest Speaker, Jim Benson, President and CEO of SpaceDev, Inc., who gave an interesting talk on his firm's endeavors.

After Jim's talk, the time came to see if anyone had one of those lucky numbers. You know, that little ticket you got when you arrived that had a number on it. Yes, the prizes were now on their way to some lucky winner. The grand prizes were won by Hal Ingram, N5CG, an Alinco DJ195T; Gus Herrera, YV5AMW, a Qualcomm Cell Phone with accessories; John Bristow a pair of M² 2M and 70cm eggbeater antennas; Dianne White, N0IZO a Kenwood THD7A; Richard Parry, W9IF a US Tower MA40. There were plenty of lucky door prizes throughout the day on Friday and Saturday. Besides all these prizes, Qualcomm had set up three of their satellite phones near registration and had a couple of hand held models for us to make calls home at no cost. This was a very nice gesture and well appreciated by all. (See Figure 1 for a complete list of donated prizes.)

The AMSAT Area Coordinators breakfast meeting was held bright and early on Sunday morning by Barry Baines, WD4ASW who discussed various innovative ways AMSAT area coordinators can help bring Amateur Radio satellite operation to the entire ham community. The breakfast was great as well and afterwards Area Coordinators had to waddle to the buses for the tour of Qualcomm and SpaceDev. Thanks to Franklin Antonio, N6NKF and Kerry Banke, N6IZW for arranging the tour and donations from Qualcomm. Also thanks to Susan Benson for the tour and refreshments at SpaceDev.



From left to right, C. Bardou and B. Eilertson of Arianespace, Karl Meinzer, DJ4ZC, and Peter Guelzow, DB2OS of AMSAT-DL delightfully share a toast for success after signing the Phase 3D launch agreement in Marburg, Germany. (AMSAT-DL photo)

Phase 3D to be Launched Aboard an ARIANE 5

MARBURG, GERMANY (October 8, 1999) AMSAT's most ambitious project to date... the International Phase 3D communications satellite...has now been accepted for launch aboard an Arianespace Ariane 5 launch vehicle.

Dr. Karl Meinzer, DJ4ZC, AMSAT-Germany's President and Phase 3D Project Leader released the following statement:

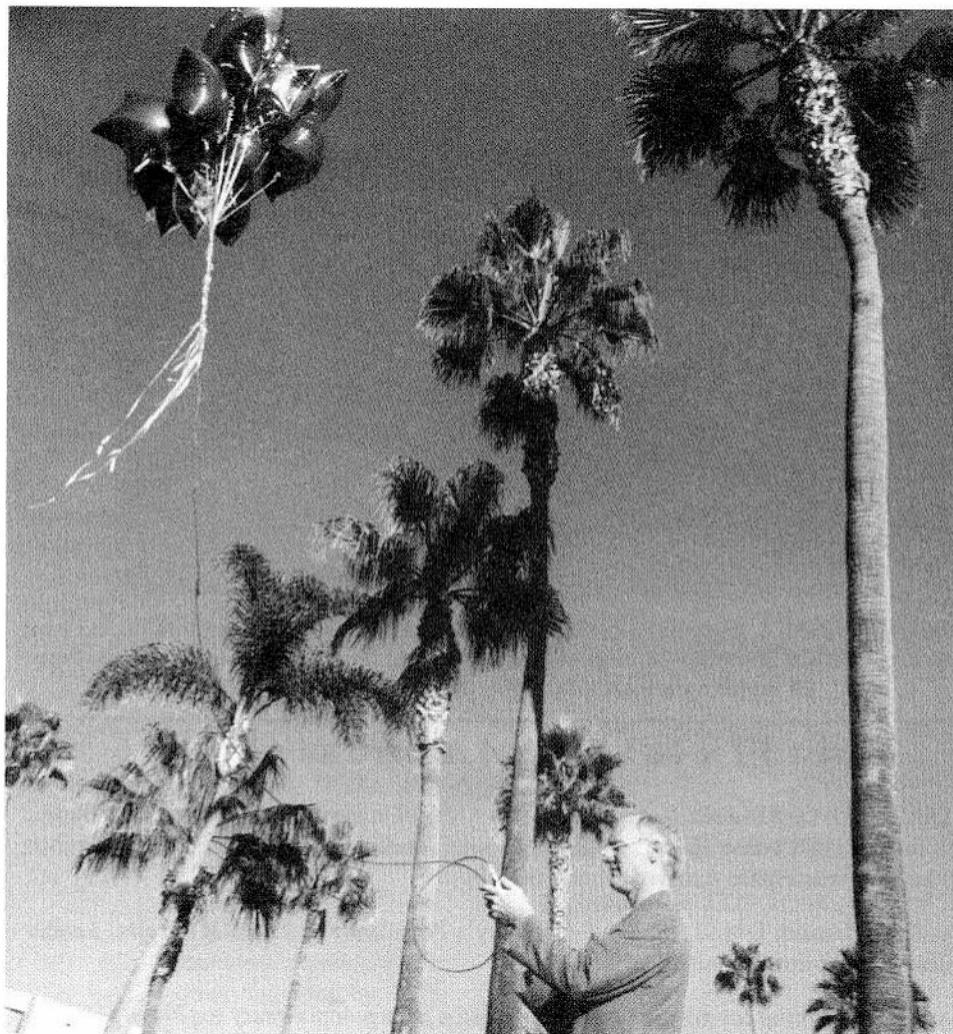
"As the primary agency responsible for securing a launch opportunity for Phase 3D, I am pleased to announce that AMSAT-Germany and Arianespace have now come to an agreement calling for the launch of Phase 3D as a secondary payload aboard the *first suitable* Ariane 5 flight."

Dr. Meinzer went on to comment that, "From the very beginning of the Phase 3D project, we considered the Ariane 5 series our primary launch vehicle. Our long history of success and mutual cooperation with both the European Space Agency (ESA) and Arianespace, coupled with our need to lift Phase 3D into a high geostationary transfer orbit, made the Ariane 5 the unanimous choice by AMSAT."

Following standard protocol, specific details of the launch agreement were not released.

AMSAT-NA President Keith Baker, KB1SF, was elated with the latest news. "I'm very pleased to see that AMSAT-DL's negotiations with Arianespace have resulted in a launch contract for Phase 3D, and I'm delighted we are again slated to fly on an Ariane vehicle," he said. "Following the resounding success of Ariane flight 503, the Ariane 5 has now proven itself to be a very capable launcher. When coupled with our many past successes with ESA and Ariane, I believe we now have an unbeatable combination. Once it is in orbit, the Phase 3D satellite will not only help us usher in the new Millennium, it will also signal the dawn of a brand new era for Amateur Radio," he concluded.

While both AMSAT presidents expressed optimism for an early launch of the satellite, Dr. Meinzer expressed caution that the wait for the *first suitable* flight could still turn out to be a long one. "While the launch of Phase 3D could come as early as the first half of the year 2000, we must remember that Ariane's launch manifests are continually being updated to accommodate market changes as well as the availability of other payloads. Thus, one or more changes to Phase 3D's anticipated launch date, along with its specific Ariane 5 mission number, are a very real possibility before our satellite actually flies," he said. ■



Always the innovator, Bob Bruiniga, WB4APR attempts to enhance his APRS reception by hoisting a flexible J-pole antenna to an effective elevation. Reportedly (hi), approaching aircraft to Lindbergh International Airport in San Diego were able to receive his APRS packets and thus avoid contact with his antenna. (Photo by Art Feller, W4ART)

Later in the afternoon and all day Monday, the AMSAT Board of Directors met. The first order of business was to install the newly elected members, Dick Daniels, W4PUJ, Bill Tynan, W3XO, Robin Haighton, VE3FRH, Barry Baines, WD4ASW and alternate Mike Gilchrist, KF4FDJ. The minutes of the Board of Directors meeting will be published in the next issue of *The AMSAT Journal*.

So how did the symposium successfully come off without a hitch? It was due to the hard work of a crew of folks such as Duane Carson, KF6UA who was in charge of bus transportation and J. Goldberg, KD6PBH who did the logistics and tour planning. Then there was Leanne Guimont, KA6UCD who kept the registration table in check and Jean Naugle, KC6QHT who coordinated with the hotel and arranged for the door prizes. Filling in some gaps was Ronalee Fitch, N6SHI. Larry Brown, W7LB

and Jan King, W3GEY provided valued advice. Also, a special thanks is in order to Jennie McGee-King who was the Qualcomm Coordinator. Throughout both days there were plenty of snacks and drinks in the AMSAT Hospitality room that was also the place to be Thursday night. All the trays were kept full and the drinks cold. The job was performed flawlessly by Bessie Spann and Dorothy Carson. At the microphone of the talk-in station was Doug Wescott, KF6QXU and the A/V equipment was kept in place and running by Bob Spann, KE6BJL. Last but not least, was the man in charge of the entire show, none other than Duane Naugle, KO6BT. Without his guidance this group of hams, husbands and wives would not have been able to pull off one of the best of the AMSAT symposia.

Next year, the 18th AMSAT Annual Meeting and Space Symposium heads east across the U.S. to Portland, Maine. Efforts

are already underway to host this symposium, so make plans to attend!

1999 AMSAT Awards

During the Saturday evening banquet, the following awards were given to various AMSAT members and supporters for their outstanding accomplishments during 1999. (Please note that the Field Operation awards are present in the Field Ops column on page 25.)

30th Anniversary Celebration

- **Eric Rosenberg, W3DQ:** For your key role in the AMSAT 30th Anniversary celebration, held at the Goddard Flight Center March 13, 1999. Your stepping in at the last minute and moderating the Saturday afternoon symposium saved the day and made it a very enjoyable event.
- **Martha Saragovitz:** For your key role in the AMSAT 30th Anniversary celebration, held at the Goddard Flight Center March 13, 1999. Without your drive and determination to make it happen, this very enjoyable event would have never taken place.
- **Dan Schultz, N8FGV:** For your key role in the AMSAT 30th Anniversary celebration, held at the Goddard Flight Center March 13, 1999. Your participation in planning and carrying out the day's activities contributed to making for an unforgettable time for all who attended.

Annual Meeting and Symposium

- **Duane Naugle KO6BT:** This is in recognition of your outstanding work in heading the team that put on the 1999 AMSAT Annual Meeting and Space Symposium in San Diego, California. Thank you Duane for all your fine work in making this gathering both enjoyable and successful. All symposium attendees very much appreciate your fine work and that of your team.
- In appreciation of your hard work in putting on the 1999 AMSAT Annual Meeting and Space Symposium. The following were important and effective members of *The Team*:
 - **Dorothy Carson**
 - **Duane Carson, KF6UA**
 - **J. Goldberg, KD6PBH**
 - **Dave Guimont, WB6LLO**
 - **Leanne Guimont, KA6UCD**
 - **Tony Long, KC6QHT**
 - **Jenny McGee King**
 - **Jean Naugle, KC6QHT**
 - **Bob Spann, KE6BJL**

General

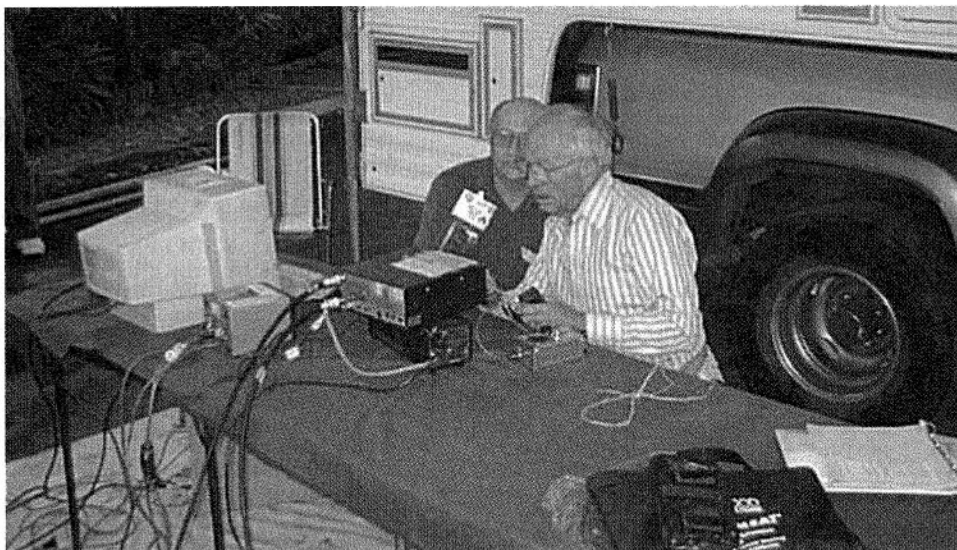
- **Joe Holman, AD7D:** In recognition of your many years as a strong supporter of AMSAT, and in particular for the years as an elected and effective member of the AMSAT Board of Directors. We will miss your participation at the Board.
- **Karen Mangold, & ADCO Advertising, Kerrville Texas:** For your outstanding artistry in the creation of original and innovative designs for AMSAT patches, decals, T-Shirts and hats. The skill you displayed,

and the long hours you devoted to this exacting task, added significantly to AMSAT's success marketing these items and thus materially helped further the organization overall objectives.

- **Stan Wood, WA4NFY:** In recognition of your years as an elected and effective member of the AMSAT Board of Directors. Your technical input to the discussions has always been of great value, particularly when dealing with Phase 3D matters. We look forward to continuing to receive your guidance in the future.

Human Spaceflight

- **Gill Carman, WA5NOM:** This is being presented in recognition of your outstanding support in the mission control Customer Support Room for the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. Your hard work in the CSR was crucial - providing a unique, once in a lifetime opportunity for five school groups to talk with the orbiting crew.
- **Frank Bauer, KA3HDO:** In recognition of you, and your team of volunteers at the Goddard Space Flight Center, for their substantial efforts on the amateur radio hardware to be launched to the International Space Station in late 1999. Frank, without your personal attention and drive this project would not have been able to deliver the first set of flight hardware.
- **Randy Becnel, W5UE:** This is presented in recognition of your outstanding support of the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. Your help in mentoring the Awty International School group, guaranteed their successful SAREX contact with STS-93.
- **Bill Boston, N3DCI:** This is presented in recognition of your outstanding support to the Amateur Radio on the International Space Station (ARISS) program; particularly your efforts to program the Ericsson radios which are to become part of the first ham station on board the International Space Station.
- **Bob Diersing, N5AHD:** This is presented in recognition of your outstanding support to the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. In appreciation of your excellent volunteer as a SAREX telebridge ground station on STS-93 as well as numerous other space shuttle missions.
- **Larry Dietrich, WD8KUJ:** This is presented in recognition of your outstanding support to the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. In appreciation of your excellent volunteer service as a SAREX telebridge ground station on STS-93 as well as numerous other space shuttle missions.
- **Robert DiRosario, KA3ZYX:** This is presented in recognition of your outstanding support to Amateur Radio on the International Space Station (ARISS) program; particularly your help in preparing the first set of radios for the International Space Station and for supporting the development of the EVA mock-ups of the external antenna systems for ARISS.
- **Leslie Eaton, KD5DYY:** This is presented in recognition of your outstanding support to the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93.



WB6LLO Special Event Satellite Station was manned by Dave Guimont, WB6LLO (r) and Steve Wilmet, WB6BDY. KB1SF (l) is watching. (Photo by Bruce Paige, KK5DO)

Your help in mentoring the Harbor View School group guaranteed their successful SAREX contact with STS-93.

- **Ericsson, Inc.:** This is presented in recognition of your outstanding support to the Amateur Radio on the International Space Station (ARISS) program. AMSAT-NA thanks Ericsson for the donation of the radio hardware which forms the heart of the first amateur radio facility on board the International Space Station.
- **Jim Gass, N3CJN:** This is presented in recognition of your outstanding support to the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. Your help in mentoring the Buzz Aldrin Elementary School group guaranteed their successful SAREX contact with STS-93. Your efforts as the SAREX webmaster are also much appreciated.
- **Brian Justin, WA1ZMS:** This is presented in recognition of your outstanding support of the Amateur Radio on the International Space Station (ARISS) program. Your efforts in securing donations of radio hardware enabled the successful completion of the first set of amateur radio hardware for the ISS.
- **Pat Kilroy, WD8LAQ:** For your support as telebridge moderator and with press releases and public outreach on all shuttle flights and particularly for the 25th SAREX flight on STS-93. Also, we commend your tremendous support to the Amateur Radio on the International Space Station (ARISS) program; particularly your efforts to program the Ericsson radios which are to become part of the first ham station on board the ISS.
- **Gerald Klatzko, ZS6BTD:** This is presented in recognition of your outstanding support to the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. In appreciation of your excellent volunteer service as a SAREX telebridge ground station on STS-93 as well as numerous other space shuttle missions.



There were many happy winners at the Saturday evening banquet! (Photo by Art Feller, W4ART)

- **Will Marchant, KC6ROL:** This is being presented in recognition of your outstanding support as the Operations Manager for the 25th and final Shuttle Amateur Radio Experiment (SAREX) activity on the STS-93 mission. Also we commend your tremendous support to the Amateur Radio on the International Space Station (ARISS) program; particularly your efforts to acquire 2 meter and 70 cm radios and your leadership in the development of the Express Pallet for the ISS.
- **MCI/Darome Telecommunications:** It would be virtually impossible to have school contacts on the educational outreach Shuttle Amateur Radio Experiment (SAREX) program without the tremendous support of MCI/Darome Telecommunications. This plaque is to express our thanks for years of outstanding support on shuttle flights. We hope to continue the partnership with school contacts with Astronauts on the International Space Station starting in the Year 2000.
- **Dale Martin, KG5U:** This is presented in recognition of your outstanding support to the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. Your help in mentoring the Harbor View School group guaranteed their successful SAREX contact with STS-93.
- **John (WD5EEV) & Karen (WD5EEU) Nickel:** This is being presented in recognition of your outstanding support in the mission control Customer Support Room for the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. This mission was one of the most difficult SAREX missions in recent years. Your hard work in the CSR was crucial - providing a unique, once in a lifetime opportunity for five school groups to talk with the orbiting crew.
- **Ron Parise, WA4SIR:** This is presented in recognition of your outstanding support to the Amateur Radio on the International Space Station (ARISS) program; particularly your efforts in preparing the antenna systems to be used by the first amateur radio station on board the International Space Station.
- **Nancy Rocheleau, WH6PN:** This is presented in recognition of your outstanding support as a telebridge ground station operator for the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93.
- **Charlie Sufana, AJ9N:** This is presented in recognition of your outstanding support to the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. Your help in mentoring the Osceola Elementary School group guaranteed their successful SAREX contact with STS-93.
- **Gordon Williams, VK6IU:** This is presented in recognition of your outstanding support to the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. In appreciation of your excellent volunteer service as a SAREX telebridge ground station on STS-93 as well as numerous other space shuttle missions.
- **Brian Zemba, N1WSO:** This is presented in recognition of your outstanding support to the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. In appreciation of your services as a SAREX telebridge ground station for the STS-93 mission.

- **Howard Ziserman, WA3GOV:** This is presented in recognition of your outstanding support to the 25th and final Shuttle Amateur Radio Experiment (SAREX) mission on STS-93. Your help in mentoring the Memorial Middle School group guaranteed their successful SAREX contact with STS-93.

Information and Publications

- **Gerald Brown, K5OE:** This is in recognition of your significant efforts to promote AMSAT via the Houston AMSAT Net with your satellite report, and also with articles and information for Amateur Radio Publications and the Internet. AMSAT looks forward to your enthusiastic continuing efforts.
- **Ken Ernandes, N2WWD:** For posting new shuttle Keps on the AMSAT Web Page after every burn, and for helping with the object sorting process after every new launch. Also for writing the "Orbital Elements" column in *CQ VHF Ham Radio Above 50 MHz*. Your efforts to effectively communicate the diverse Amateur Radio satellite program to the amateur radio community is greatly appreciated.
- **Dan James, NN0DJ:** For continued dedication, in the face of a very large workload involving a great deal of traveling, for the publishing of the AMSAT News Service.
- **Andy MacAllister, W5ACM:** In appreciation for writing an Amateur Radio Satellite column in *73 Amateur Radio Today*. Your efforts to effectively communicate the diverse Amateur Radio satellite program to the amateur radio community is greatly appreciated.
- **Roy Welch, W0SL:** For dedicated service as AMSAT Software manager and *Elmer* to many of the new Digital Satellite operators.

Phase 3D

- **Onur Atabek, Goddard Space Flight Center:** This Plaque is presented to you in recognition and appreciation of the excellent support you provided to the AMSAT Phase 3D spacecraft and to the Phase 3D team during the vibration testing at Goddard Space Flight Center. As the vibration test manager you were instrumental in making the necessary arrangements for the test as well as assisting in the test procedure development. Thank you for your help.
- **John Cavallo, KB3BWP:** In recognition of your role in the performance of thermal vacuum testing of the Phase 3D Amateur Radio satellite at Orbital Sciences Corporation. These tests were extremely important in the qualification of that satellite to ensure that it will perform properly in the environment of space. Without this generous support from you and the other Orbital Sciences people involved, the Phase 3D team would have had to spend significant additional, and unavailable, funds in order to perform these tests elsewhere.
- **Dick Daniels, W4PUJ:** You have worked tirelessly as a volunteer for AMSAT and in particular for the Phase 3D project. You built and prepared the propellant Flow Assembly (PFA) for Flight. You have also been instrumental in making arrangements for the Phase 3D Vibration tests at NASA Goddard Space Flight Center. It is through your tenacity and good work that these tests were possible. Thanks for a job well done.

- **Robert (Bob) Davis, KF4KSS:** Your contributions to the success of the Phase 3D project have been so many as to make it impossible to enumerate here. Whatever the need has been, you have been there to meet and exceed the requirement. Voluntarily you put in many long hours on Phase 3D; far more than what would have been expected from anyone. You have been essential to the success of Phase 3D. *You are the Man for anything mechanical on the spacecraft.* Thank you Bob for making the Phase 3D construction a success.
- **Jerry Duncan:** In recognition of your role in the performance of thermal vacuum testing of the Phase 3D Amateur Radio satellite at Orbital Sciences Corporation. These tests were extremely important in the qualification of the satellite to ensure that it will perform properly in the environment of space. Without this generous support from you and the other Orbital Sciences people, the Phase 3D team would have had to spend significant additional, and unavailable, funds in order to perform these tests elsewhere.
- **Bdale Garbee, N3EUA:** Bdale, your contributions to AMSAT are many. On the Phase 3D project you have contributed many hours designing, building and testing a computer to support the GPS experiment. When circumstances beyond your control rendered that computer unnecessary, you turned your attention to RUDAK, spending many hours testing that unit both at your home and at the Phase 3D lab in Orlando. Thanks for your continued support of Phase 3D and AMSAT.
- **Walter Goodale, Goddard Space Flight Center:** This plaque is presented to you in recognition of your support in preparation for and conduct of the Phase 3D spacecraft vibration tests in August 1999. As designated point of contact you maintained an active interface during the planning phase and took the initiative in making arrangements for necessary clearances, supplies and equipment. Your efforts were an integral part of the successful accomplishment of the tests.
- **Chuck Green, N0ADI:** Chuck - you are one of those volunteers that everyone wants on their team. You have spent several months away from home in Tucson to be at the lab in Orlando, providing support in whatever way you could. You are always willing to help. Your *Can Do* spirit is an inspiration to the team. Thanks Chuck for all your support on the Phase 3D project.
- **Werner Haas DJ5KQ:** For your many years of Devoted Service to the Amateur Radio Satellite Fraternity from your North American Colleagues and Friends.
- **John Human, N8VZW:** In recognition of the time you spent volunteering your time, on a full time basis for several weeks, and at your own expense. You worked tirelessly at the Phase 3D lab and contributed your considerable talent and experience as a Ham operator and Ex AT&T employee to the project. Thanks John for your help. It's hams like you that make Phase 3D possible.
- **Craig Jacobson, KA0KQC:** You have made the arrangements with NASA KSC so that the Phase 3D project could borrow the necessary R.F. test equipment to verify that the Phase 3D transmitters and receivers were functioning correctly. Due to the wide frequency requirements (up to 24 GHz), this equipment would have been very expensive

Figure 1

Many Thanks to the Following Firms and Individuals for Donating Prizes!

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and difficult to obtain elsewhere. A very valuable contribution to the Phase 3D effort, especially as these tests were conducted on several different occasions. Thanks Craig for being there when you were needed.

- **Dick Jansson, WD4FAB:** For your long-time faithful service as a Phase 3D team volunteer. Your continued support has been vital in keeping the Phase 3D project on track. Your work on the thermal analysis has resulted in the design and completion of the thermal blankets. In addition you have continued to contribute many hours as a volunteer machinist and you have supported Phase 3D in any way you could. Thanks Dick for staying the course.

- **Rick Leon, KA1RHL:** You have continued to contribute your considerable talents to the Phase 3D team effort. You have worn many hats on this project, and have been instrumental in the design of the solar panel hinge springs as well as the solar panel release system. You have also been heavily involved in the SBS qualification testing and the final assembly of the SBS. Thanks Rick for a job well done.
- **Lou McFadin, W5DID:** For your many years of outstanding service to AMSAT-NA as the International Phase 3D Satellite Project's Integration Laboratory Manager. Your uncompromising integrity, keen engineering talent, solid leadership skills and selfless devotion to duty have consistently

provided a much needed *steady hand on the tiller* that's kept AMSAT-NA's major contributions to the project on track. Your singular efforts have been instrumental in bringing the integration and testing of AMSAT's largest and most complex satellite project to a successful conclusion. In short, it simply would not have happened without you.

- **Curtis Oakley, Goddard Space Flight Center:** This plaque is presented to you for your excellent work in preparation for and during the Phase 3D spacecraft vibration tests in August 1999. Your initiative in developing procedures to assure the safe handling of the isopropyl alcohol used to simulate propellants in the Phase 3D tanks

and your success in securing their acceptance was critical to the conduct of the tests. Without your support the tests could not have been accomplished. AMSAT and its worldwide membership thank you for your important contributions to the project.

tests elsewhere. Our thanks to all at Orbital Sciences Corporation who took part in preparing and performing these tests. Your efforts represent an outstanding example of Good Corporate Citizenship.

- **Orbital Sciences Corporation:** In recognition of your company's contribution of its facilities to support the thermal vacuum testing of the Phase 3D Amateur Radio satellite. These tests were extremely important in the qualification of the satellite to ensure that it will perform properly in the environment of space. Without this generous support from Orbital Sciences, the Phase 3D team would have had to spend significant additional, and unavailable, funds in order to perform these

- **Harold Price, NK6K:** Harold, your contributions to AMSAT are many. On the Phase 3D project you have contributed your SCOS operating system to the RUDAK along with your time in bringing the operating system on line. As well you served as the responsible person for preparing the GPS interface software for Phase 3D, and you made sure that the GPS system was properly integrated into Phase 3D. Thanks Harold for your continued support of Phase 3D and AMSAT.

- **Sanjay (Jay) Ramdas:** You worked at the Phase 3D lab as a volunteer for several months before coming on as a full time team member. Your outstanding work and *can do* attitude made you the obvious choice when the Phase 3D work load demanded we bring on more full time help in order to meet schedule. Thanks Jay, you are a real asset to the Phase 3D team.

- **Rex Richardson:** In recognition of your key role in the performance of thermal vacuum testing of the Phase 3D Amateur Radio satellite at Orbital Sciences Corporation. These tests were extremely important in the qualification of the satellite to ensure that it will perform properly in the environment of space. Without this generous support from you and the other Orbital Sciences people involved, the Phase 3D team would have had to spend significant additional, and unavailable, funds in order to perform these tests elsewhere.

- **John Rosco:** In recognition of your role in the performance of thermal vacuum testing of the Phase 3D Amateur Radio satellite at Orbital Sciences Corporation. These tests were extremely important in the qualification of the satellite to ensure that it will perform properly in the environment of space. Without this generous support from you and the other Orbital Sciences people involved, the Phase 3D team would have had to spend significant additional, and unavailable, funds in order to perform these tests elsewhere.

- **Harry Shipley:** In recognition of your role in the performance of thermal vacuum testing of the Phase 3D Amateur Radio satellite at Orbital Sciences Corporation. These tests were extremely important in the qualification of the satellite to ensure that it will perform properly in the environment of space. Without this generous support from you and the other Orbital Sciences people involved, the Phase 3D team would have had to spend significant additional, and unavailable, funds in order to perform these tests elsewhere.

Satellite and Field Operations

- **Cliff Buttshardt, K7RR:** For helping the South African *Sunsat Team* during a prolonged launch campaign at Vandenberg AFB and keeping the rest of us informed.

- **Chuck Duey, K10AG:** For the development of the *Arrow Antenna* and its continued use to introduce new operators to the *Easy Birds*.

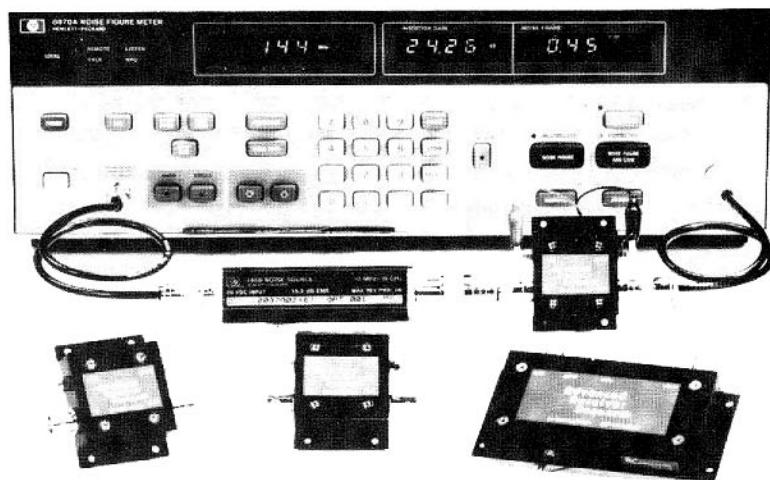
- **The Huntsville Amateur Radio Club, K4BFT:** For the *First Place* finish in the 1999 Radio Amateur Satellite Corporation Field Day event on June 26th and 27th. ARRL operating Class 5A with emergency power and portable operation.

- **Chris Jackson, G7UPN/ZL2TPO:** For providing the AMSAT world with the WISP Station Control and Communications package and for dedicated service as command station for the *UoSats* including the commissioning of TO-31 and UO-36 this year.

- **Stacy Mills, W4SM:** For continued dedication to the care and feeding of our old friend, AO-10.

- **Gerald Schmitt, KK5YY:** For many inspired demonstrations of *Easy Bird* operations around the USA, including Dayton. ■

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The Doppler Frequency Effect of Phase 3D, Part 2

Franz J. Bellen, DJ1YQ - Translated by John J. Bubbers, W1GYD

Editor's Note: Part 1 of this article covered the calculation of Doppler shift extensively. Part 1 appeared in the September/October 1999 issue of The AMSAT Journal. In Part 2 the slope of Phase 3D's Doppler frequency shift (rate of frequency change versus time) is discussed. As in the previous article, the considerations are for the beginning of the drift phase and for a point in time 15 years later. This article first appeared in the AMSAT-DL Journal, Vol 26:1, March/May, 99 as Part 2 of a two part series.

Slope definition: frequency change per unit of time. Frequency (Hertz) and seconds were chosen as the units. The worst case consideration takes into account an overhead satellite pass at perigee. Figure 1 shows the summary of Figures 3 and 4 from Part 1, although presented somewhat differently. The slope curves were taken from the maximum shift values of ± 31.8 kHz and ± 13.6 kHz. The reference frequency is again 1 GHz, so that the values can be re-calculated comfortably to other (linear related) frequencies.

How does one start with slopes? This question will be answered presently using the following two examples:

- **96k Bd Mailbox Operation:** For error-free operation the satellite frequencies must be kept within ± 6 kHz. If the result of the curves indicates a slope of 300 Hz/s, then a frequency correction must be made every 20 seconds ($6000 \text{ Hz}/300 \text{ Hz/s}$).
- **SSB Operation:** To achieve good speech intelligibility the frequency should not drift off more than 150 Hz. Again, if the slope is calculated at 300 Hertz, then the uplink and downlink frequency must be corrected every 0.5 seconds ($150 \text{ Hz}/300 \text{ Hz/s}$).

Calculations of the Limit Values for Phase 3D

Figures 2 and 3 present the Doppler shifts and the slope values for an overhead pass at the perigee. Figure 2 shows the beginning of the drift phase, and Figure 3 for a point in time that is 15 years later. At the beginning of the drift phase the slope has a maximum value of 600 Hz/s at 1 GHz. This means for Phase 3D SSB in the S-band the frequency ($150 \text{ Hz} * 1 \text{ GHz}/2.4 \text{ GHz} * 600 \text{ Hz/s} = 0.10$

s) must be corrected 10 times per second. To reduce the load on the computer in this instance, one can fall back on an optimization strategy, which was presented in reference 2. Then there are only five corrections per second needed, which is no problem for a fast computer, which also has other chores to take care of.

The demands on the hardware and software over the years, in regard to the Doppler compensation, will become smaller, as the height at perigee increases. After 15 years the greatest shift at 1 GHz will be only 13

Hz/s, (see Figure 3), a recalculated value for the 2 meter and 70 cm bands, which can then be corrected manually.

One should take note of the time axis. The very large slope values at beginning of the drift phase in Figure 2, appear for only 5 minutes during each pass. If a station could not perform the rapid compensations, there is no great loss. On the other hand, the satellite offers the experimentally oriented amateurs five minutes per pass for interesting experiments.

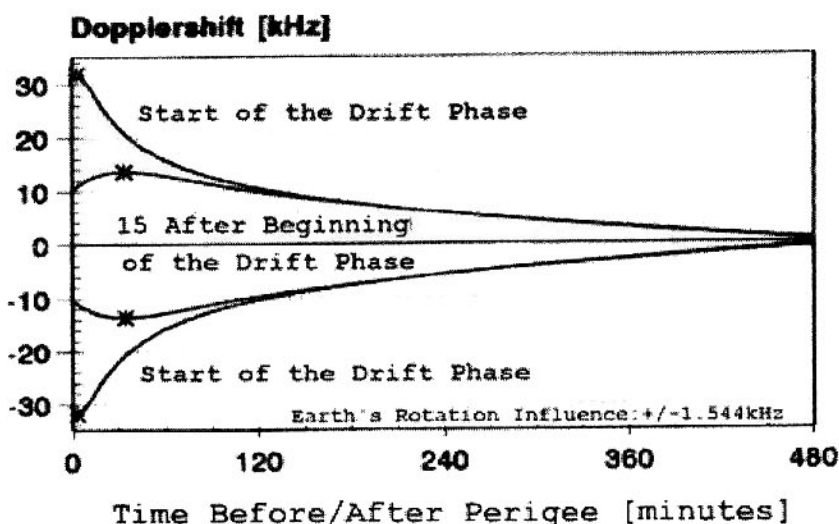


Figure 1. Maximum Doppler Effect on Phase 3D, $f = 1 \text{ GHz}$, at Beginning of Drift Phase and After 15 Years.

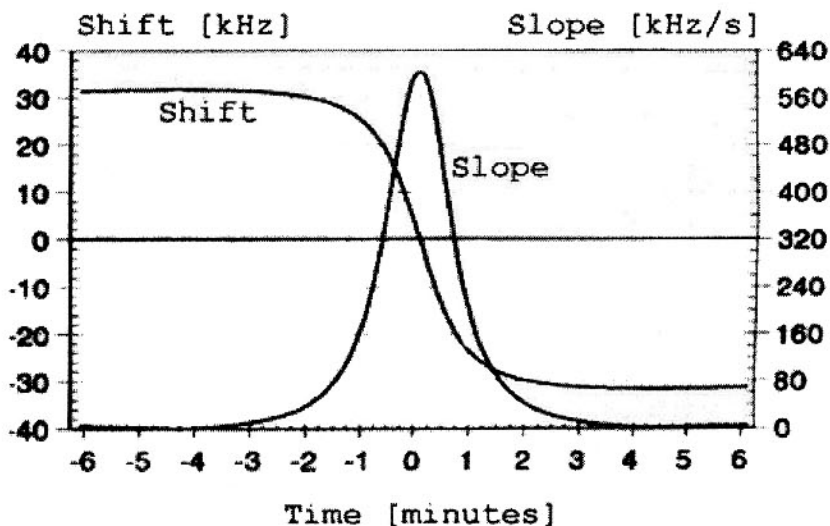


Figure 2. Doppler Shift and Doppler Slope Change at Perigee, $f = 1 \text{ GHz}$, at the Beginning of the Drift Phase.

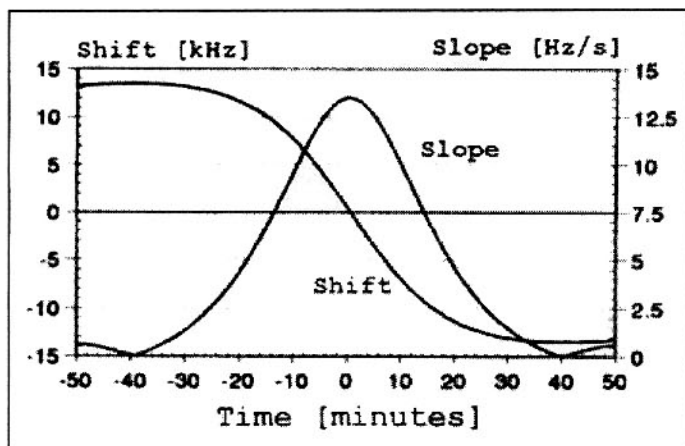


Figure 3. Doppler Shift and Slope Change at Perigee, $f = 1$ GHz, 15 Years after Beginning of Drift Phase.

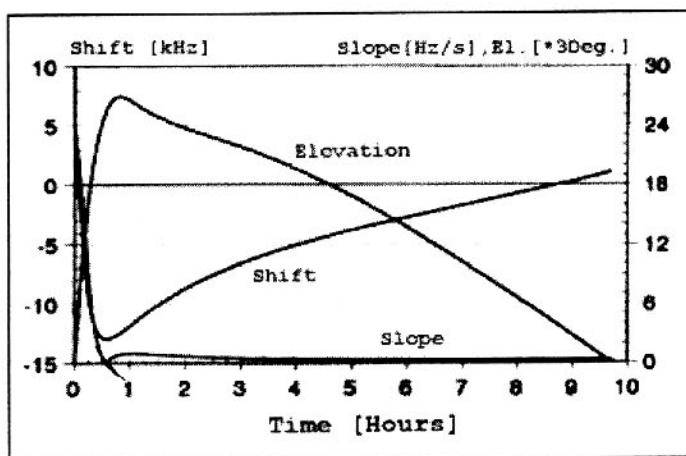


Figure 4. Doppler Shift and Slope Change and Elevation at the Beginning of the Drift Phase at JO31JN, $f = 1$ GHz.

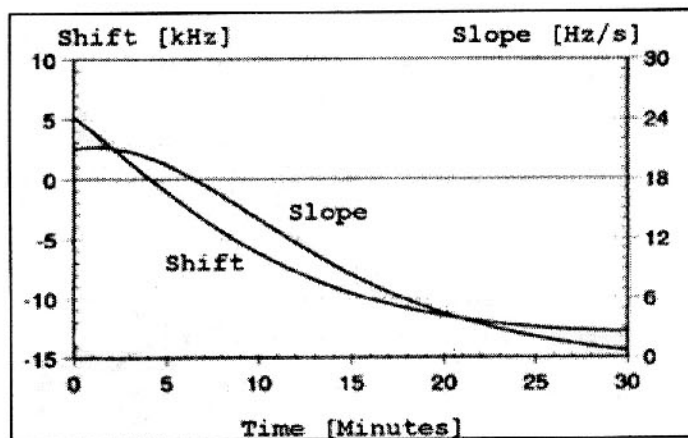


Figure 5. As in Figure 4, however, from AOS until AOS + 30 Minutes and without Elevation Change.

In order to prevent a panic because of the large slope at the beginning of the drift phase, Figures 4 through 6 show a theoretical pass at the author's QTH (JO-31-jn). The visible part of the pass stretches from MA 4.6 to MA 160.8, and the maximum elevation angle is 80.8 degrees.

From Figure 4 it is evident that the access time to the satellite is nearly 10 hours. In that time period, the time span of high slope values is less than 0.5 hours. This part is shown in Figure 5 with higher resolution.

Figure 6 shows the remaining 9.5 hours using different graphic resolution. During this total time period manual Doppler shift correction is possible in Mode-S operation.

Summary

The Doppler shifts, which appear on Phase 3D, are very large only at the beginning of the drift phase and then only when the satellite passes through perigee. This is an ideal time for experiments. This condition lasts for only about three years since (a) the perigee altitude, h_p , increases, see Figure 2 in [1], and (b) the angle of perigee will move to the earth's southern hemisphere, so that the perigee will no longer be visible in our region (see Figure 7).

With modern transceivers which have a serial port in combination with a fast computer and the proper software for the satellite launch, which might then be available on the market, control of the Doppler shift should be available for every satellite position.

Conclusions

Everything is in the ready state. Only the satellite in orbit is missing. We hope that Dr. Karl Meinzer and his team will be successful in finding a launch possibility for Phase 3D. We will keep our fingers crossed for him.

References

1. Bellen, Franz J., DJ1YQ, "Dopplereffekt bei P3-D, Teil 1" *AMSAT-DL Journal*, 25:4 December/February 1999
2. Bellen, Franz, DJ1YQ "Optimierte Kompensation des Dopplereffektes bei Foniebetrieb ber Fuji-OSCAR-20 und OSCAR-29" *AMSAT-DL Journal*, 24:3. Set/Nov. 1997 ■

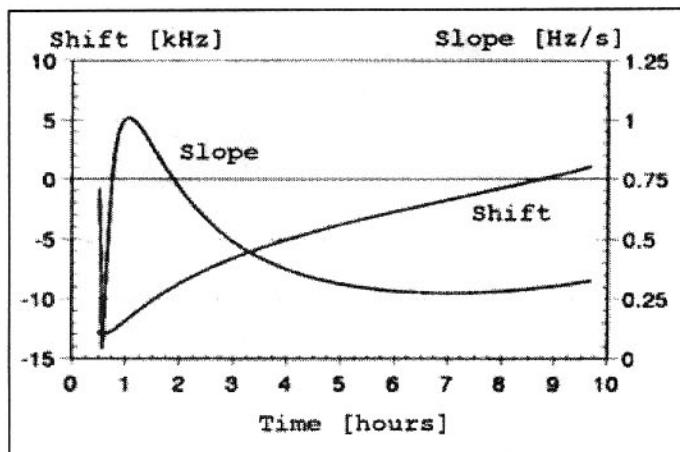


Figure 6. As in Figure 4, however, from AOS until AOS + 30 Minutes until LOS and without Elevation Change.

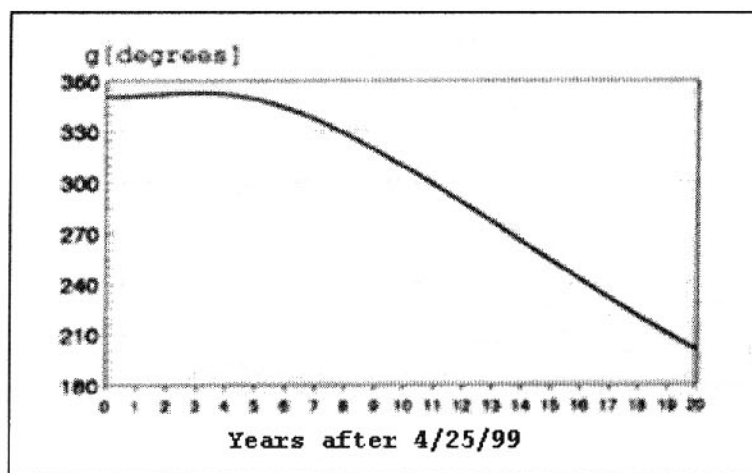


Figure 7. Change of Phase3D's Perigee Angle after the Beginning of the Drift Phase.

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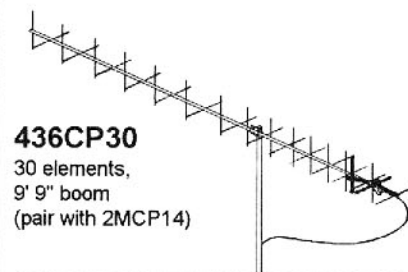
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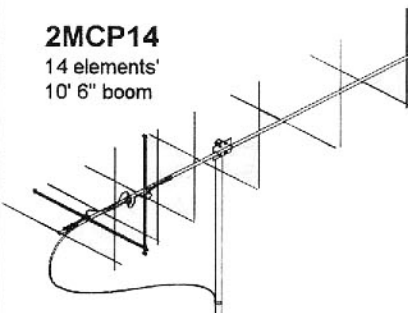
436CP42-U/G

42 elements,
18' 10" tapered boom
(pair with 2MCP22)



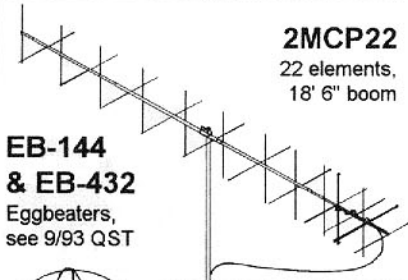
436CP30

30 elements,
9' 9" boom
(pair with 2MCP14)



2MCP14

14 elements
10' 6" boom

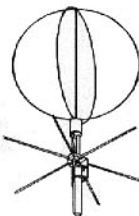


2MCP22

22 elements,
18' 6" boom

EB-144 & EB-432

Eggbeaters,
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StenSat Journal: *Our Experience Building a Picosatellite*

Hank Heidt, N4AFL (hheidt@erols.com) & Kevin Doherty (dohertk@ttc.com)

StenSat is one of five picosatellites that will be launched from Stanford's Orbiting Picosatellite Automated Launcher (OPAL) after it reaches orbit. A DARPA team built two of the picosatellites (which will be tethered together) and a team of women undergraduate engineers from Santa Clara University (Artemis Team) built the remaining two picosatellites.

Our unexpected foray into the world of satellite design began in early November 1998 when Hank Heidt, N4AFL learned via the AMSAT e-mail list that there was a potential satellite design opportunity as part of the Stanford OPAL program. He discounted the message at first, but when the same message went by a week later (again with no response) he decided "well, what the hell."

The StenSat Team (*Help! We've Agreed to Build a Satellite!*)

Hank's first move was to ask the advice and help of Kevin Doherty and Dave Niemi, two friends and former housemates. All three at one time shared an old, run-down farmhouse called Stenhouse, which was the focal point of a group of friends with somewhat unconventional outlooks. After numerous e-mails and some discussion, the initial core team of Hank, Kevin and Dave had formed.

Phase 1: Interactions with Stanford

We contacted Bob Twiggs, KE6QMD director of the Stanford Space Systems Development Laboratory. Bob was interested, and challenged us to put a mass model of our satellite in his hands within a week. Given the picosat interface document and a cooperative machinist this wasn't too difficult.

Design Concepts (*Hand Waving via the Internet*)

Now that Stanford was taking us somewhat seriously we started to toss ideas around. Via e-mail and the Internet we researched a number of missions, but found it difficult to reach consensus. Some of our ideas were too complex, and others impractical, but during the Thanksgiving weekend we started a design notebook and began serious tradeoff studies to focus in on a workable satellite.

Phase 2: Discussions with Stanford

On December 15, 1998, the team met with Bob Twiggs at Goddard SFC. During the meeting Bob confirmed that we were a backup to another amateur team (which we had already suspected). Another alarming bit of information was that flight hardware would be required no later than April 1, 1999 – less than four months away. At this point we drastically reduced our plans – there simply wasn't time to implement anything

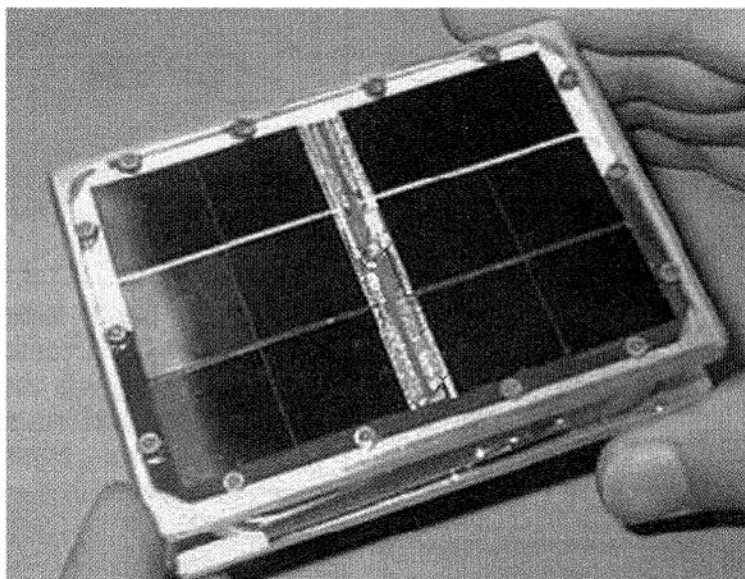
complicated. During the meeting we walked through design concerns such as attitude control, power, and antenna release. At the end of the meeting Bob generously offered to send us a batch of GaAs solar cells for our satellite as well as a batch of Si solar cells that were left over from the Mars Explorer project. After the meeting we nailed down our basic mission to a mode J single channel FM transponder with DTMF control and AX.25 packet telemetry downlink.

OK, Build It! (*Problems, Problems, More Problems*)

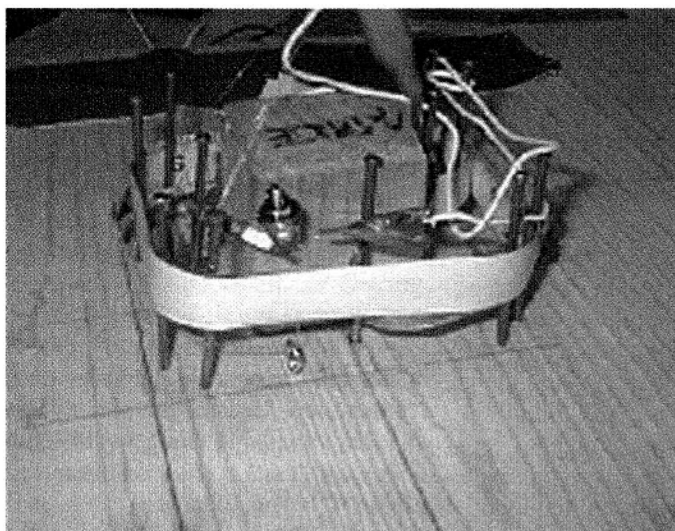
One of the first design problems that we tackled in January was our picosat antenna release. Inside of the OPAL mothership two picosats will be positioned end to end in each launch tube, and Stanford required that no external structures be exposed or released from the picosat until after it has completely cleared the launcher. But some sort of deployable antenna was going to be necessary. Numerous impractical ideas later, we settled on the following scheme: the antennas, composed of ½ inch wide carpenter's measuring tape, were coiled about the perimeter of the satellite, tied down with fishing line, and released by heating a short nichrome wire to melt the fishing line. To evaluate the concept we built a crudely constructed test bed out of nails, measuring tape, and 8-pound test fishing line. With a little experimentation we discovered that the fishing line could easily be melted by briefly connecting three tiny 1/3 Af Nicad batteries across the nichrome, controlled by a FET switch connected to a basic stamp PIC processor.

So far so good, we were definitely making progress. Activating our test bed would cause the antennas to explode from their pre-deployment position with a frighteningly loud *sproing* and snap into their post-deployment position. We decided that we had suitably proven the concept, and got busy finalizing our structural design and putting together our mechanical drawings.

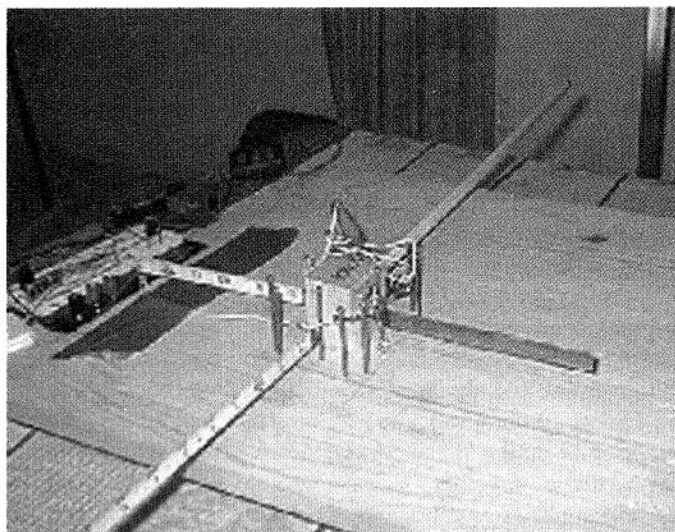
The team discovered quite early that the basic stamp controller was not going to meet all of our needs, so we decided to build our controller around the much more powerful Micro Chip PIC16C73 controller. After much hair pulling Hank implemented basic Morse



StenSat Picosatellite.



Prototype antenna before deployment.



Prototype antenna after deployment.

code telemetry and some of StenSat's command uplink functionality in PIC assembly language. He also started to take a crack at implementing AX.25 packet telemetry as well, but it quickly became apparent that he would not have everything completed by April 1st. Fortunately we had been looking at alternative controller options and we had contacted Carl Wick, N3MIM an Associate Professor at the U.S. Naval Academy and the designer of the Clement, Micro Interface Module (MIM) an AX.25 packet radio telemetry unit based on the PIC16C73. We were pleasantly surprised to learn that he was interested in our project despite the tight delivery schedule. Meeting with Carl at the Naval Academy in mid-February we explained our basic design, showed him our antenna release prototype and controller prototype.

Shortly after the meeting Carl agreed to develop the StenSat controller software by modifying the software he had already developed for the Clement MIM. With Carl's expert assistance we quickly finalized our controller design. The controller would be connected to a microprocessor supervisory circuit that acts both as a low voltage cutoff monitor and also as a 100ms external watchdog timer to help guard against radiation latchups. After assigning pins on the PIC to talk to the DTMF decoder and reset the watchdog, we allocated four more pins on the PIC processor (via switching FET's) to control the antenna release, TX power level, RX squelch (RSSI) and the main power bus. The remaining pins on the PIC processor would be used to support the following telemetry: temperature, bus current, bus voltage, receiver RSSI and three sun sensors (top face, long and short sides).

One of the things that we dreaded doing was sending in a Part 97 notification. Since none of us went to law school, we were a bit intimidated by the FCC notification procedure, but with some help from Perry Klein, W3PK and Bob Bruninga, WB4APR (who was puzzling through his own FCC notification) we had few problems completing the paperwork. We are also very grateful to Graham Ratcliff, VK5AGR, the IARU Amateur Satellite Frequency Coordinator who found us satellite frequencies and vetted the frequencies with authorities on three continents, and all in less than a week!

From this point on we faced another crisis. Five days before the March 7th structural model delivery milestone our machinist informed us that, due to unforeseen circumstances, he would not be able to machine our chassis for us. Calling just about every machine shop in the Washington Area Yellow pages, we were very lucky to find a shop that accepted small orders and that also happened to have some available time. The machine shop completed our order the evening before our structural model was due. We then worked until 2 AM knocking a structural model together. We shipped our model to Stanford that same morning, and crossed our fingers that our late night construction project would not violently fly apart during Stanford's OPAL preliminary launcher integration and shake tests.

Panic Mode (What Do You Mean, We're the Primary?!?)

After delivering our structural model to Stanford on March 1, 1998. Hank received a phone call from Bob Twiggs informing us

that the other ham team had dropped out and that we were no longer a backup satellite. Hank quickly shared the good news with the rest of the team. Between exchanges of congratulations and curses we tried not to panic! We only had one month left to finish our flight ready satellite.

By the time that we had reached this stage in our project we decided that we should rename our picosat the *Digikey Satellite*. With the hours ticking by to the delivery date we really counted on the FED-X packages to show up on our doorstep each morning. Circuit board turnaround times were fast, but not fast enough – while we had circuit boards for the controller and solar panels, it was quickly determined that the flight RF deck (the most complex assembly on StenSat) would need to be built using breadboard techniques.

Kevin spent most of his time for the next few weeks working with tweezers under a stereo microscope, carefully positioning flea-sized components on and about the transceiver chipset. The transmitter, receiver, and power amplifier designs were pulled directly out of the data sheets and application notes for the devices used. These designs did have to be modified to use components we had on hand; we couldn't wait on backorders.

We had some astounding luck. The receiver and transmitter both came up and worked on the first try! We quickly coupled them together with an audio network and tested the transponder. Then apparently disaster struck for when we powered up the transponder and keyed the Yaesu dual band handheld all we heard was high pitched screeching noise and the receiver and transmitter were both working a minute ago! We quickly figured

out that what we were hearing was an audio feedback squeal through the handheld. We plugged in some headphones and discovered that the transponder worked fine (good audio quality too)! Kevin quickly integrated our power amp, fiddled with its bias circuit and set our transmitter output to half a watt. We were not able to get suitable coupling transformers in time so we decided to use home-brew bead baluns instead. Kevin added the receiver squelch and audio mixer for the downlink and designed an elliptical filter (using MicroSim) to eliminate processor noise on the signal coming down. He also threw together a narrowband preselector/amplifier to filter out all those megawatt TV stations. It took several attempts, but we eventually fit everything into the chassis.

Once the satellite was assembled, we were amazed – we were using less than half the available volume! We had room for at least one more board, and potentially two more, and we weren't using the undersides of the solar panels for anything except the battery overcharge limiter. After spending much of the weekend outside in the sun performing final integration testing we used a syringe to get epoxy in, on, and around every component as Kevin summed up the operation, *pot that sucker 'till it's a solid brick*. We carefully wrapped the antennas and tied them down for the last time. One last session with the syringe, and now StenSat was as close to a solid mass of epoxy as we could manage without fouling the antenna release mechanism. One last look inside and then the top cover was fastened down and the screws staked with more epoxy – no one will ever see the inside again. Not surprisingly, the

satellite was due at Stanford the next day. One hallmark of our effort – nothing was ever ready early, but we always managed to come through at the last minute.

StenSat was placed in its light-tight storage bag (to keep StenSat from deciding that it had been launched, and deploying its antennas). The bag was rolled in bubble wrap, then nestled into foam peanuts in a large cardboard box for shipping to Stanford. Kevin then took the package to local Parcel Plus. Kevin decided to insure it for \$1,000 and the proprietor looked at Kevin strangely. "It's going to cost you more for insurance than it will to ship it – what is it, anyway?" "Ah...well, it's a satellite – it's going up this October". "Oh", he replied, "This is our first satellite. I guess I should mark the box **"FRAGILE."**

Summary of Our Design

The receiver and transmitter designs were directly out of Motorola's data sheets for the 13136 and 13175 FM receiver and transmitter chips. The RX preamp was based on one presented in the data sheet, but modified to have a more narrowband response. The TX power amp was very loosely based on an RF2155 sample design; the device was targeted at 900 MHz applications, and making it work at 70 cm was a cut-and-try operation. Receiver to transmitter audio coupling and telemetry mixing was managed with a passive network, and squelch was accomplished using an open-collector parallel output pin from the PIC to crowbar the receiver audio in the mixer.

Our total out of pocket expenses for StenSat were about 2,000 dollars. Other than paying for a lot of next day shipping, the most expensive components were the chassis (\$375 each, times two), RX and TX crystals (several hundred dollars for custom frequencies) and PIC microcontrollers (we went through several revisions). The GaAs solar cells we used on

StenSat were donated from Stanford. We ordered enough components (excluding the chassis) to build five picosatellites. This turned out to be a lifesaver as many components were destroyed, lost, sacrificed, or used in some other way.

Future Opportunities

Both Bob Twiggs, KE6QMD and Rick Fleeter, WA8VGK are big proponents of the micro/picosatellite concept. In his article the "Home-Brew Ionosphere" (see *The AMSAT Journal*, January/February 1999), Rick Fleeter outlines his ideas on clusters of tiny (under 10 kg) satellites that can be launched inexpensively by piggybacking on large launch vehicles or as hitchhikers and *Get Away Specials* on shuttle flights. Those mini-satellites could be standardized around a specific geometry such as OPAL's (1 by 3 by 4 inch cube) and could be offered as build-it-yourself kits that could be constructed by local Amateur Clubs and Students. With just a few of those satellites in orbit we would be begin to have many periods a day of good coverage. Eventually by launching clusters of those inexpensive satellites as low power (watt) FM transponders you could have nearly continuous coverage mirroring that of your local FM repeater but covering hundreds of miles around you. Satellite cost including launch would be on the order of a few thousand dollars, within the reach of most amateur clubs.

Notes

"Home-Brew Ionosphere," Rick Fleeter, WA8VGK, *The AMSAT Journal*, January / February 1999

StenSat: <http://www.erols.com/hheidt/>

Stanford OPAL Project:
<http://ssdl.stanford.edu/opal/index.html>

Radiation Modeling: <http://www.spennis.oma.be>

Micro Chip PIC Resources:
<http://www.geocities.com/SiliconValley/Way/5807/>

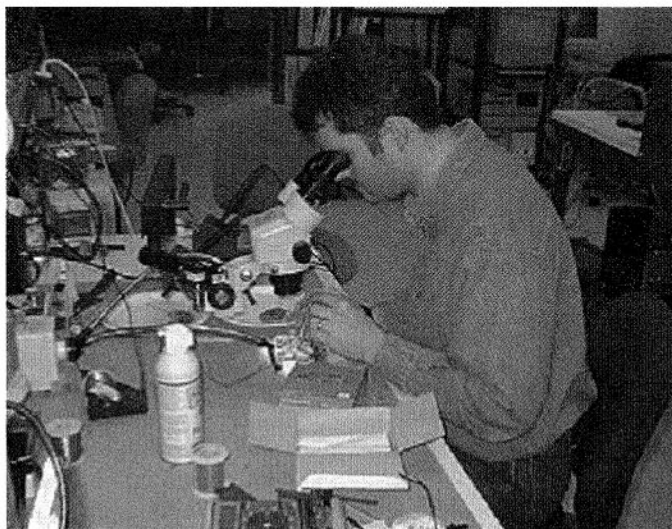
Express Printed Circuit Boards:
<http://www.expresspcb.com/>

PartMiner Search Engine:
<http://www.partminer.com>

Nichrome Wire: <http://www.wiretron.com/>

Fishing Line: <http://www.sportsauthority.com/>

Spring Steel Carpenters Tape:
<http://www.hechinger.com/> ■



Kevin Doherty working on StenSat.

435-438 MHz Patch Antenna

Cliff Buttschardt, K7RR

Patch antennas have been in use for years primarily in aircraft and space vehicles. Most are *microstrip* antenna designs since a rigid dielectric is used to separate the ground plane from the radiator. Almost all are linearly polarized since the *patch* is square. Two modifications are presented in which circular polarization is obtained as well as the use of air dielectric allowing ordinary construction and some amount of VSWR adjustment

through mechanical means. A great deal of experimentation resulted in a simple design for 435/438 MHz.

One of the earliest practical low profile antenna designs was presented in NASA Tech Brief in March 1996. Both crossed dipole and microstrip was used. A suggested approach to circular polarization in which unequal feedline lengths feeding square patch elements was demonstrated. These designs

used multiple patches to increase gain and provide some measure of circular polarization stability. Earlier, Harold Ward, W1GE presented a circularly polarized design of a patch antenna for GPS in which a single coaxial feedpoint is used with a slightly off square radiator. W1GE used design information from a number of commercial sources including information supplied by Roger Cox, WB0DGF. Both presented information in which air dielectric was used. W1GE presented an off diagonal tap design producing right hand circular polarization. The basic concept is that both the shorter and longer sides of the patch are excited. The shortest path from the coaxial attachment point to the edge is excited first followed by the longer path to the longer dimension. This then produces circular polarization. Proving this in practice is difficult as well as demonstrating the *circularity* of the end result. Note how close to the 1575 MHz design the scaled 438 MHz antenna became!

One of the better patch designs was worked out by Stan Wood, WA4NFY and his efforts to optimize the antenna aboard Phase 3D. While these patches are edge fed with coax rather than *tap* fed, the many pictures of the Phase 3D antenna suite that appear in *The AMSAT Journal* illustrated the concept. Of the many articles reviewed regarding air dielectric a set of added fundamental guidelines can be listed:

Air dielectric has the highest gain and lowest loss since the larger patch size has larger aperture and smallest beamwidth.

The spacing between the ground plane and the radiator must be kept reasonably large, between 0.01 and 0.04 wavelength with .05 wavelength a practical maximum. The resonant frequency of the antenna can be varied considerably by small changes in spacing.

Bandwidth is improved by larger patch spacings since the Q is lower. The antenna is less affected by moisture and buckling. Note that in this effort, the final spacing is varied to obtain a better match to the feedline once the tap points have been determined.

Ground based antennas should be Right Hand Circularly polarized if only one is to be used, but both RHC and LHC is advantageous. The

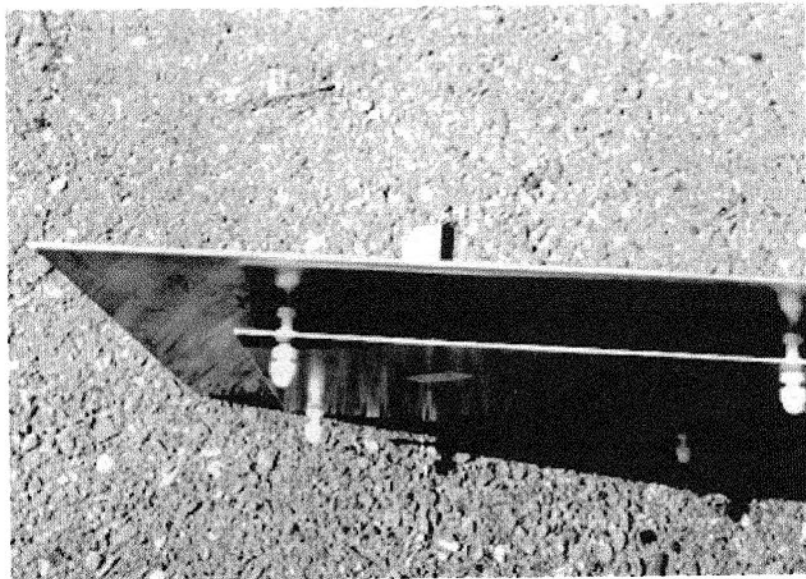
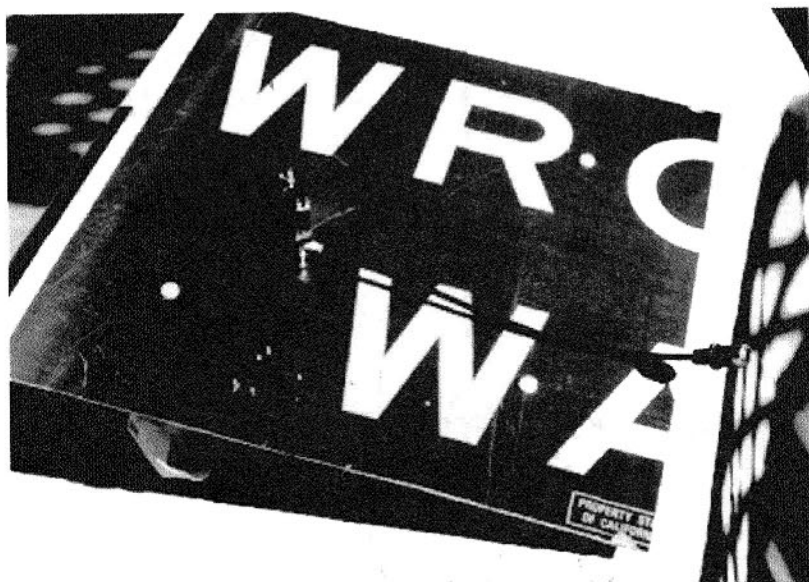
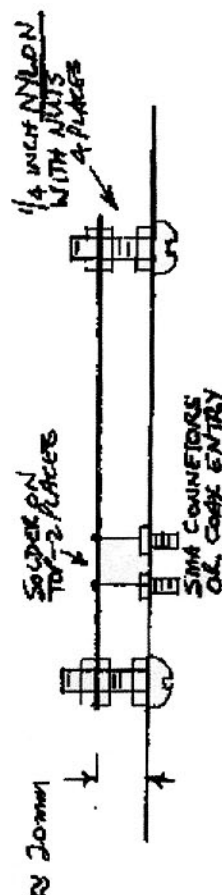
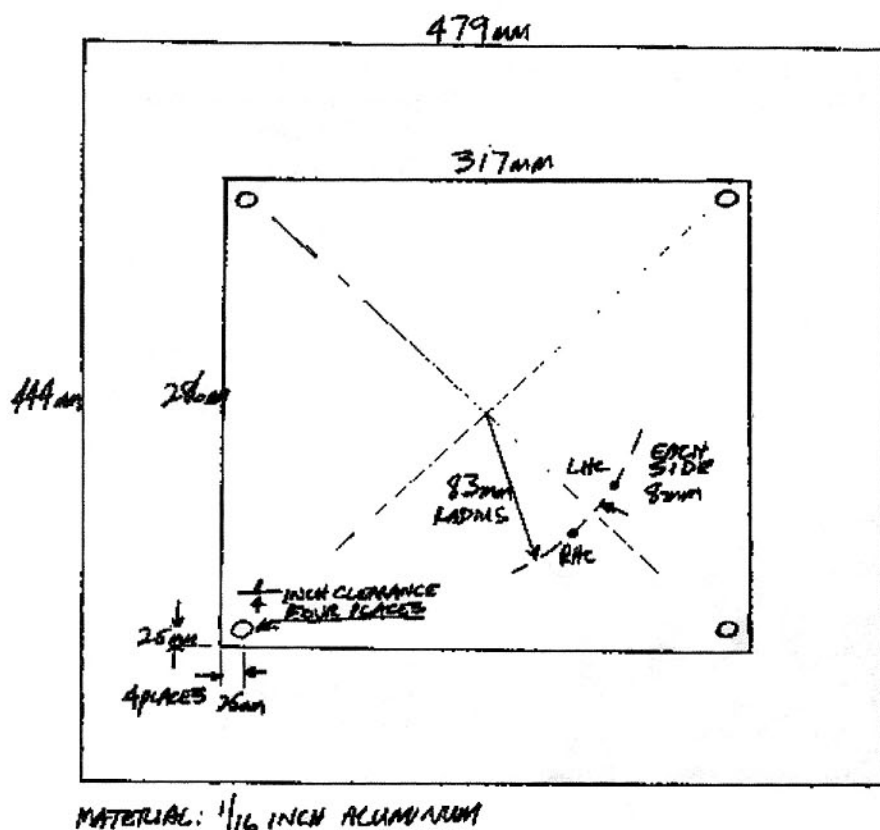


Figure 1 illustrates the two aluminum plates that need to be fashioned. The dimensions are critical in that best results can be obtained with careful construction. Many hours of experimentation have gone into the selection of the compromised tap points. The final antenna design benefits from hours of listening to signals and calculation which has proven the old adage that both sources are useful!



436 MHz PATCH ANTENNA
KTRR AUG 1999

Figure 2. 435-438 MHz Patch Antenna Design.

ability to switch between both rapidly is highly desirable.

However the incorporation of a suitable switching system on a single patch proved difficult. Two designs resulted, the simpler using a SMA relay placed as close to the underside of the ground plane as possible. These relays are rather expensive if not obtained surplus. The advantage is that each SMA connection can be optimized before the relay system is installed. A second design uses three quarter wavelengths of coaxial cable and an ordinary type N relay.

Both seem able to pass one hundred watts with ease. The stub arrangement using coaxial cable was fashioned by first placing the cable on a RF bridge, then selectively cutting to length. A free space fullwave in millimeters is given by 299974 divided by the frequency in MHz, then multiplied by the velocity factor and 0.75 for an approximate

final coax cable length. The result was a line of 340 mm for solid coax. Each line is then cut with an additional 30 mm of exposed center conductor for later mounting. All was easily accomplished on an Autek VHF analyzer in minutes. The bridge is selectively tuned for minimum impedance since an open odd quarter wavelength inverts impedance. The very fact that 30 mm of center conductor is left floating compensates for fringing rather well.

The photographs in Figures 1 and 3 illustrate a rather inexpensive source of 1/16 inch aluminum sheet. Indeed they are segments of damaged road signs formally used by the highways department! More importantly, 1.6 mm material (1/16 inch) is used. Air dielectric avoids the criticality of material thickness. In the four corners, 1/4 inch nylon bolts support the patch. Each has three nuts threaded so that the distance between the patch and the ground plane can be varied. VSWR can be finalized

in this fashion. For those who want a better VSWR vary the size of the wire between the SMA connector and the patch as this does affect the match slightly. Most are content with a minimum value by adjusting spacing. Do solder to the patch as a bit of effort and proper flux a solder joint can be made. In the coaxial stub design, connect the shield to the groundplane side nearest the patch radiator as the fields are largest there.

As to the proper method of determining circularity, signals from local 70 cm repeaters were used assuming that the multiple dipole collinear gain antenna produced nearly pure vertical radiation. The patch was rotated in an effort see a three dB decrease at all four 45 degree points. The results were far from conclusive probably due to ground reflections. Better results were obtained with a six turn helix. Circularity was good and cross gain approximately minus ten dB. No gain figures were obtained, but published

figures indicate between 8 and 10 dBic should be expected. It was most gratifying to note the cross modulation from local repeaters was gone due to the low gain at lower elevation angles. As a final note, radomes can be made of large salad bowls or trash cans cut off where necessary. One can also favor some satellites by noting the most desirable position in the sky and mounting the antenna directly upon a sloping roof in that direction..

References

NASA Tech Brief, Vol. 20, No.3, Item #98, *Antennas For Receiving Signals Broadcast Via Satellites*

Ward, H. R., "A Patch Antenna for the Global Positioning System," *QST*, October 1995, page 44.

Wood, Stan and Jansson, Dick, *The AMSAT Journal*, March/April 1993, page 18. ■

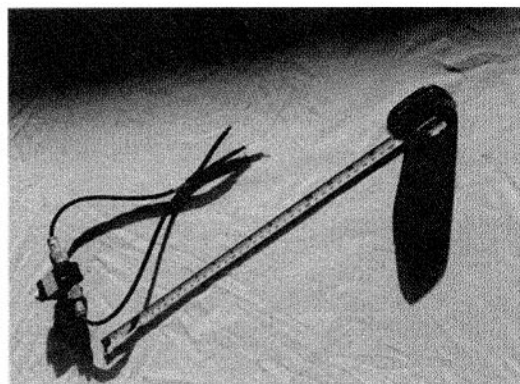
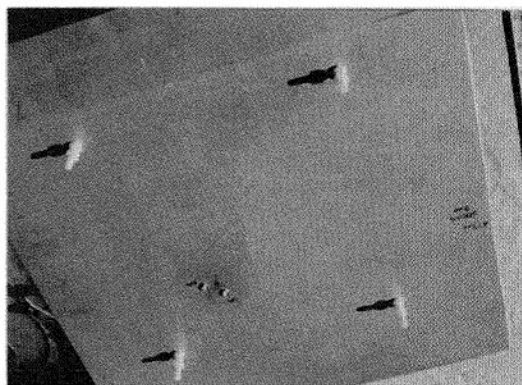


Figure 3. Additional details of the 435-438 MHz patch antenna.

Satellite Orbital Elements

By Ray Hoad, W45QGD

Satellite	AO-10	FO-20	RS-12/13	RS-15	FO-29	AO-27	UO-11	MIR
Catalog Number	14129	20480	21089	23439	24278	22825	14781	16609
Epoch Time	99315.45830671	99322.00601078	99322.12419243	99322.61157000	99321.83998123	99322.15572914	99321.96249080	99322.86415698
Element Set	604	195	204	423	295	766	223	83
Inclination	27.1735	99.0257	82.9231	64.8147	98.5785	98.4391	97.9499	51.6552
RA of Node	0.8025	127.4599	343.0734	162.6723	252.5718	21.7558	284.4725	269.8787
Eccentricity	0.6020535	0.0540903	0.0029781	0.0162579	0.0351783	0.000806	0.0012604	0.0001487
Arg of Perigee	2.2426	175.8691	359.4951	325.6243	56.5672	160.1617	64.3052	186.4646
Mean Anomaly	359.7495	184.7149	0.6158	33.4235	306.8589	199.9871	295.9447	173.6377
Mean Motion	2.05869415	12.83258595	13.74154353	11.27533748	13.52686726	14.27976504	14.70964007	15.80158182
Decay Rate	-0.0000013	-0.00000001	0.00000067	-0.00000032	0.00000224	0.00000512	0.00003453	0.00111349
Epoch Rev	12342	45806	44055	20165	16058	32021	84109	78577
Satellite	AO-16	DO-17	WO-18	LO-19	UO-22	KO-23	KO-25	ISS
Catalog Number	20439	20440	20441	20442	21575	22077	22828	25544
Epoch Time	99322.18722803	99322.15063969	99322.24445286	99322.20582550	99322.14084878	99321.83231759	99322.21680397	99322.86838721
Element Set	275	278	285	300	997	882	750	106
Inclination	98.4697	98.4786	98.4775	98.4844	98.1799	66.0783	98.4363	51.5904
RA of Node	36.5517	38.2123	38.0516	39.3461	355.2851	95.018	22.492	136.4669
Eccentricity	0.0011012	0.0011571	0.0012214	0.0012647	0.0008284	0.000376	0.0009582	0.0011535
Arg of Perigee	118.3647	119.9018	120.7035	120.858	112.4669	186.0382	141.8314	207.5648
Mean Anomaly	241.8651	240.3321	239.5347	239.3863	247.7395	174.0591	218.3545	152.4715
Mean Motion	14.30299407	14.30463854	14.30402708	14.30533619	14.37441365	12.86330364	14.28483245	15.66650448
Decay Rate	0.00000647	0.0000064	0.0000065	0.00000617	0.0000073	-0.00000037	0.00000598	0.0005513
Epoch Rev	51258	51262	51263	51266	43745	34140	28840	5678
Satellite	IO-26	TO-31	GO-32	SO-33	PO-34	SO-35	UO-36	JAWSAT (Est)
Catalog Number	22826	25396	25397	25509	25520	25636	25693	32766
Epoch Time	99322.19256474	99322.18794015	99322.15804165	99322.22009327	99321.78147978	99322.74254079	99322.30536749	99289.07604166
Element Set	765	220	251	96	118	122	110	1
Inclination	98.4393	98.7449	98.7449	31.442	28.4615	96.4764	64.5619	100
RA of Node	22.3222	34.6275	34.4775	6.8365	161.3062	213.1768	35.5989	101
Eccentricity	0.0008239	0.0001622	0.0001631	0.0366971	0.0007881	0.0154293	0.0026391	0.0001
Arg of Perigee	161.1508	9.4872	11.6774	33.0104	152.0756	127.1871	326.8233	0
Mean Anomaly	198.9969	350.6403	348.4443	329.2917	208.0233	234.3524	33.1212	180
Mean Motion	14.28105904	14.22464105	14.2229611	14.24244129	15.04345962	14.41014349	14.73365814	14.4259
Decay Rate	0.00000604	-0.00000044	-0.00000044	0.00001104	0.000046	0.00000791	0.00001216	0
Epoch Rev	32024	7051	7052	5558	5785	3863	3108	1

Observations from Norway

John A. Hackett, LA2QAA (la2qaa@amsat.org)

Editor's Note: The following two articles by LA2QAA and GM1SXX present construction tips on building a microwave transverter.

Since a lot of radio amateurs still refer to **microwaves** as *THE BLACK ART*....Allan Copland, GM1SXX and myself decided to experiment and see if it was possible to get away with using inexpensive off-the-shelf components in applications where high cost parts were normally used. The idea was twofold:

- Try to dispel the myth that there was something *magic* about microwaves.
- Attempt to convince other amateurs that a microwave station for Phase 3D could be built without sticking up the local bank.

After much experimenting in both Paisley, Scotland and Frei Island, Norway we have come to the following conclusions:

- It *is* possible to build a microwave station for Phase 3D's mode L/S without being among the *affluent*.

- One can get away with using *El Cheapo* components *in some places* but not all.
- Adequate *grounding* and construction technique decides the success or failure of a microwave project.

We decided that GM1SXX would be responsible for the *guts* of the project, that is to say, the transmit oscillator. Meanwhile LA2QAA would *mess* with mixers and a suitable 1w PA. (This was a bit unfair since GM1SXX claims to have a complete brain whereas it is a well known fact that LA2QAA has to make do with only half of one).

Al designed and etched the GM1SXX / LA2QAA oscillator using the well known *coal pit* (Colpitts) design followed by a tripler and a pair of doublers. Using a 93.6667 MHz *rock* gives an output at 1124 MHz which is suitable for an IF for a standard 2m rig.

Meanwhile, back at the ranch, LA2QAA tried various mixers and post mixer amps which were *not* very successful! However, the 1 watt PA was very successful and in fact delivered 1.4 watts at 1124 MHz from 32mW of drive from an LMW oscillator. The

amplifier used 1 x BFR91, 1 x BFG90 and 1 x BFQ34 transistors. It was based on an original design by Sam Abraham, G4DDK. (Any potential microwaver not knowing that call sign must bear the consequences).

A few more attempts were made at building a suitable mixer module without success. The conclusion was that if LA2QAA was having trouble...others new to microwaves would probably make the same mistakes.

It was then decided to try a different approach. Purchase ready-made boards and build a station comprising *part kit and part homebrew*. This project was a complete success (see Figure 1).

The box is made from 1mm copper sheet, bent up then the seams soldered by placing it on an electrical hotplate! Likewise the lid...making an RF tight enclosure. The box has N-type connectors for signals and a waterproof screw type connector for DC.

Figure 1 is an LMW Electronics oscillator built into an LA2QAA-type enclosure made from double-sided PCB material. (The top is removed in the Figure 1 photo). The LMW oscillator delivers 40mW when tuned properly.

To the left of the oscillator is a small double sided PCB enclosure containing a -6dB resistive pad using chip resistors....to give the necessary drive level of 10mW for the mixer.

The module at the bottom of the photo is a SSB Electronics mixer/amplifier board that delivers 1W at 1268 MHz. The 144 MHz drive level is 2 watts. I use my old TS-700G rig as an exciter. This delivers 5 watts so I built an external attenuator to drop the nominal 5 watts down to 2 watts for the SSB Electronics module. (This attenuator is *outboard* and is not contained in the transmitter box).

Each module is connected by multiples of one halfwavelength of RG-58 coax and BNC connectors. This is to preserve a constant 50 ohm impedance. Random lengths of coax at these frequencies can function as transmission line transformers!

For use with Phase 3D it is estimated that 10-15 watts of RF power will be adequate

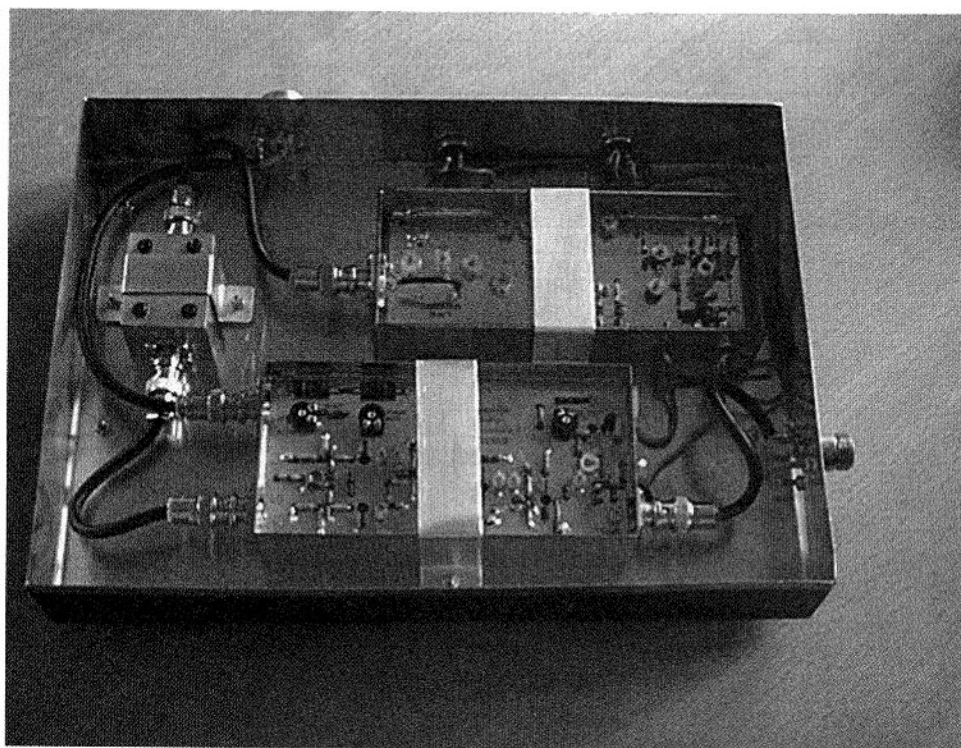


Figure 1. LA2QAA and GM1SXX LMW oscillator.

when using an antenna with 10+dB gain, i.e. a 15 turn RHCP helical.

By far the easiest method of generating 10+ watts at 1268 MHz is by use of an integrated *brick* amplifier. It is important to note that such a *brick* has to dissipate *a lot* of heat so adequate heatsinking is essential (see Figure 2). GM1SXX and myself shy away from using fans and other mechanical parts. (If you lived in minus 32C degrees in winter you'd realize why!)

Figure 3 is a view of the inside of the amplifier box. Both the transmitter and amplifier are mounted directly at the antenna.

For receiving I can use either a modified DRAKE 2880 receive converter and a 2m rig or the G0MRF 1.3 GHz to 70cm converter.

Used in conjunction with a 15t helical for TX and a 20t helical for RX (both RHCP). I expect a reasonable signal via Phase 3D.

This project didn't cost the Earth and is an economical way of becoming QRV on the lower microwave bands of the Phase 3D satellite.

73, John, LA2QAA.

John Alan Hackett, Torrvveien 10,
N-6520, Frei, Norway ■

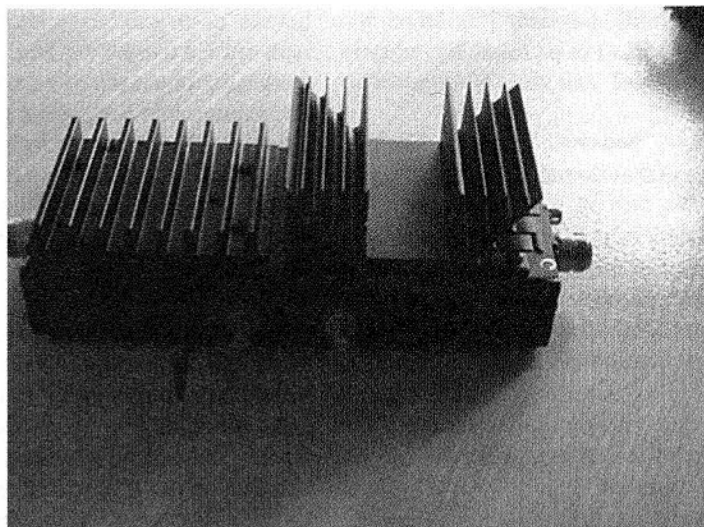


Figure 2. Heatsink for integrated amplifier.

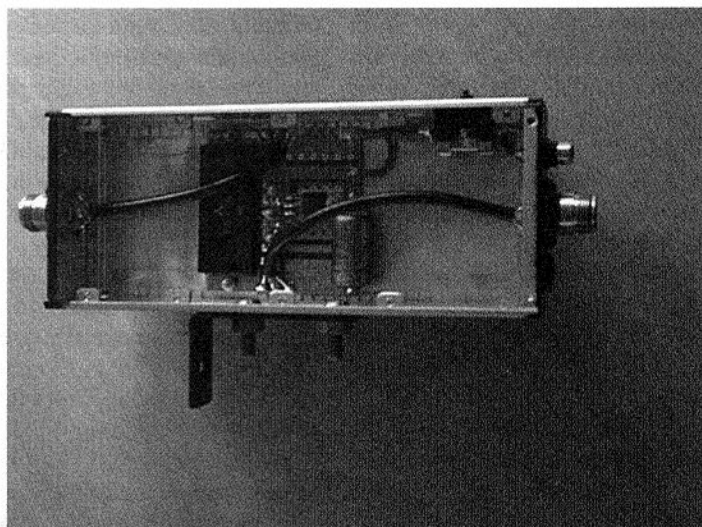


Figure 3. Inside of the amplifier box.

UNVLO2 Universal Local Oscillator Review

Allan Copland, GM1SXX (gm1ssx@amsat.org)

Circuit Description

This short article is aimed at beginners who want to get their feet wet on the lower microwave bands.

The UNVLO2 universal local oscillator from LMW Electronics is a *building block* in kit form that can form the heart of a microwave transverter system for the 1-1.3GHz frequency range.

The oscillator unit uses a fifth overtone crystal in the 90-115MHz range in a simple one transistor (2n918) oscillator employing an S18 TOKO orange coil for crystal netting. This stage feeds a buffer/doubler stage (2n5179) the output of which is used to drive a class C tripler (BFR91) stage followed by another doubler stage (BFR91). The overall *12 multiplication scheme is very typical of this sort of circuit and extensive printed microstrip filtering is used between stages to select the correct harmonics for amplification. A final class A amplifier stage

(BFR91) provides a high level (approx. 40milliwatts) output to drive a transmit strip or transmit mixer/amplifier stage. A low level (5MW) output is also available from the three-element halfwave output filter to drive a receive converter or similar. The designers claim that all unwanted products should be typically 60dB down. I had no way to verify this but the filtering used is better than that employed by some of the *competition*.

The builder has to construct the RF chokes used (4 off). These consist of a ferrite bead with three turns of enamelled wire through each. No wire is supplied for this purpose.

Unfortunately, although I have permission to reprint the circuit diagram, I felt that the scanned image was not of suitable quality to grace the pages of *The AMSAT Journal* or *OSCAR News*.

Construction & Testing

My kit arrived in a big *Jiffy* bag and was promptly emptied out onto the worktable and the extensive paperwork searched for the circuit diagram and board overlay. I put all the other documentation aside and decided to build the kit *blind* using just the parts list and board overlay simply to determine how straightforward (or otherwise!) construction and testing would be.

Armed with these two pieces of paper, the PCB and the bag of components, I made a start on the unit.

I was pleasantly surprised to find that the PCB was through hole-plated, roller tinned and had a good quality screen-printed component placement overlay. I didn't need the parts placement sheet after all! The first task was to check that the components were all present and correct. Missing from the kit was a trimmer (VC11 on the overlay, used for tuning the center element of the three stage output bandpass filter). I was a bit annoyed at

this but really it was for me not a problem. I have a *deep* junkbox and found a suitable replacement there. For a beginner, this sort of thing might be more of a nuisance. This sort of component is not always readily available unless you live in a big city.

What you get for your money is the PCB and all the board-mounted components except a crystal.

A bundle of notes is provided as photocopied sheets. The builder must supply a crystal, output connector and a close fitting metal cabinet in which to house the unit. Suitable crystals are readily available from a variety of sources either in *stock* frequencies or as *specials* if you need an unusual frequency.

The kit uses mainly standard leaded components of good quality and the many trimmers used are of the foil type. At 1.3GHz, these trimmers are more cost effective than the much more expensive SKY and MURATA types. For the beginner, these capacitors are ideal. They are big and chunky and you can easily see how meshed the plates are.

It is usual with microwave equipment to mount the PCB in its enclosure before work commences on construction and so I needed

a suitable metal box into which I could build the kit.

For this I used a trick *stolen* from John Hackett, LA2QAA - some off cuts of double-sided PCB material were chopped up in a guillotine to form sides and ends of a DIY enclosure. I scribed *guide lines* on the PCB material that was to form the sides and ends of the box as a soldering guide. The oscillator PCB and the side panels were clamped in a large vice. I tack soldered the ends of the side panel in place using a 60W iron and then rechecked that they were square. Once satisfied, I seam soldered the long sides, taking great care not to block any of the component holes. Some of these holes are fairly close to the board edge, so a fair bit of care needs to be taken over this. I turned the board over in the vice and repeated the procedure on the other side of the circuit board.

At this point, I began the construction of the kit starting first with all the resistors followed by the fixed capacitors with the larger components - coils, trimmer capacitors and transistors being fitted last.

Construction was very straightforward with no problems, thanks to the printed overlay. This was one of the best quality boards I've ever worked on. Who needs instructions! Take care though with the identification of the components, especially the very small resistors used. The colour bands can be hard to read and components wrongly fitted to double-sided plated-through holes are notoriously difficult to de-solder.

A 96MHz crystal from my junkbox was fitted - this should give 1152 MHz output ($96 \times 12!$)

Two coils have to be wound for use in the first doubler stage. These are wound in opposite directions with a 4mm drill bit as a *former*. In conjunction with their associated trimmers, these tune to the second harmonic of the crystal ($96\text{MHz} \times 2$ in my case). No wire was supplied to wind the coils so I used some tinned copper wire from a roll that has been kicking around the shack for years. The coils are 1.5 turns each and I spaced the turns one wire thickness apart. I *guesstimated* a suitable height above the PCB for these.

Once all the components were in place, I soldered the end panels of the case into place. If you use PCB as a case material, cut the end panels to size last, that way you can

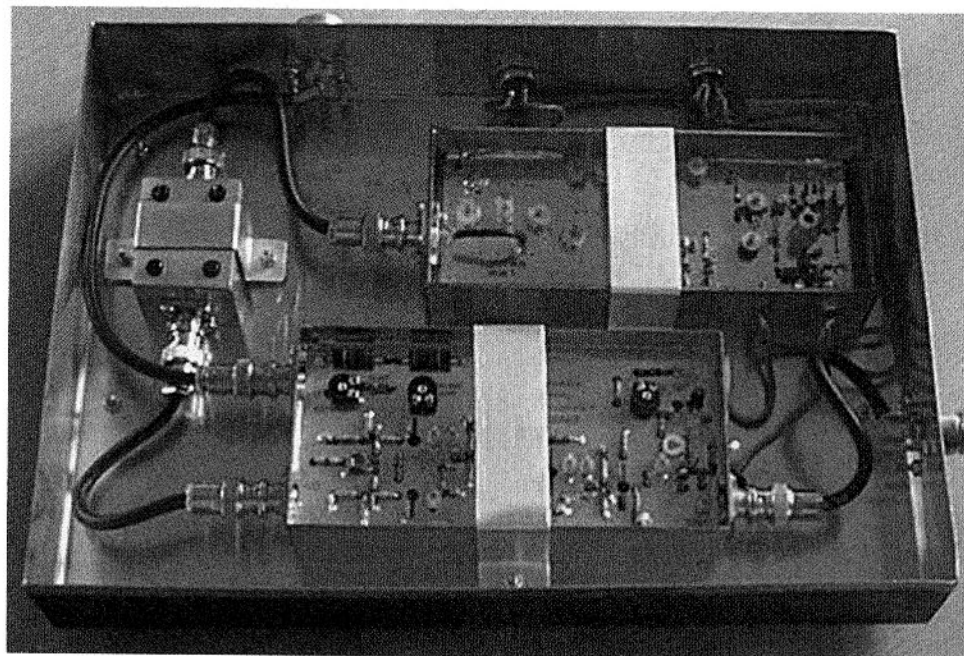


Figure 1. Universal Oscillator Boxed PCB in a Typical Application.

accommodate any errors in the shape of your box due to things not being exactly square.

Some sheet copper (any decent art store) forms the top and bottom covers. Make your lid a bit oversize (*generous* is best) fold the extra over and cut some *fingers* into the overlap to keep the lid in place. If you have never used this method of constructing boxes, you really should try it. You'll be surprised at how good they are. PCB boxes are lightweight, robust and best of all inexpensive. Oh, and they come in any size you like! *Springing* the fingers cut in the lid material should keep them in place.

With the board populated with components and the box soldered in place, I fitted an SMA connector to the box wall at the output port and a 1000pF feed-through capacitor on the side wall to feed the 13.8V DC power to the module. That done, a quick resistance check showed that there were no shorts on the power supply, so I connected it to my bench supply and fired it up. A quick check with the frequency meter showed that the oscillator stage was working so I set it to the correct frequency and began tuning up the remainder of the circuitry.

This is where the problems started. To make a long story short, I could not get the first doubler stage to work no matter what I did. I could 'see' RF going in to the transistor base, the voltages were sensible both on the base and collector of the doubler transistor but nothing I could do including swearing loudly would produce RF at the collector. Thoroughly annoyed, I went and had a cup of tea and watched telly for a half-hour before returning to the problem. This is when I thought that maybe I should look at the instructions! (The man's a genius - LA2QAA!)

This unit was built by John Hackett, LA2QAA of *Observations from Norway* fame. This chassis contains a complete transmit upconverter from 2M to 23cm. The UNVLO2 is the top right hand board. The one below it is a transmit converter (2M - 23cm) from SSB Electronics. The copper box on the middle to top left of the photo is a DIY input attenuator. Note the DIY copper enclosure used on the local oscillator module.

Sorting out the Mess!

I started checking the component values around the oscillator and doubler. Everything was as it should be. In

desperation, I returned to the supplied notes. EUREKA, hidden in a very poor quality photocopy was 'L3 - Orange S18, Fe core'. I had been supplied with an aluminium core. A quick rummage in the junkbox produced a ferrite core which I fitted in place of the ally one. Did it work now? Yes, 288MHz .. my doubler was tripling - how odd! A quick tweak of the two foil trimmers in the doubler stage and it was happily doubling as advertised.

I tuned the remainder of the strip 'blind' without reference to the supplied literature. I wanted to see how easy it would be to align this strip using just my DFM. I had the unit producing RF after only a couple of minutes work and on the correct frequency. Then, I compared my settings to the ones shown in the documentation. Sad to say, mine were different. Tuning capacitors C5/6/7 on my strip were fully meshed but the booklet said that they should be 20 percent meshed. A **huge** difference. I tweaked them to the advertised settings and the RF output rose a little. This will be familiar to anyone used to tuning up printed microstrip filters. The moral of the story - always read the instructions!

Further testing showed that this is a **very** stable oscillator and I have been highly satisfied with its performance. It performs as advertised, tuning it up is simple (if you read the booklet!) and it has no obvious vices. This oscillator board is large, the PCB is uncluttered and easy to build. Even for a relative beginner. Several surface-mount capacitors are used in the design, for interstage coupling and the de-coupling of microstrip filter fingers carrying DC to the transistor collectors. These are of the 0805 size and although many beginners tend to think of SMD components as *fiddly*, this is really not the case. If you have normal eyesight, a cocktail stick and a small tipped soldering iron are the only tools you need. If like me, your eyesight is lousy, a small eyeglass or a *helping hands* with a magnifier lens will assist further. Trust me, SMD is **not** fiddly to use, it is the best thing since sliced bread.

SMD Capacitor Pairs

The SMD capacitors used to decouple the tuned lines are fitted in pairs, side by side. This provides effective decoupling in a small physical space. The technique I use to solder these is as follows - tin one pad lightly and when cooled place the first chip capacitor in the correct position on the pad. Hold the chip

in place with your cocktail stick, heat the pre-tinned pad until the solder reflows and the component drops flat onto the surface of the pad and count to ten .. for the solder to harden.

Lightly tin the other pad (with the first component in place on it.. but not yet soldered). Place the second chip capacitor beside the first - hold in place and reflow the solder on the pad you just tinned .. adding a little more solder if needed. Both components should now be securely soldered in place at that pad.

Return to the first pad and melt the solder, adding a little more if necessary to produce a small 'fillet'.

When cooled, repeat the procedure on the other pad. Sounds fiddly but takes much less to do than to type the description of how to do it! With only a little practice, you'll be wondering what all the fuss was about.

Why SMD?

The SMD capacitors are used in the signal path in place of leaded types to reduce self inductance and provide better repeatability in the circuit. After all, constructors have widely differing ideas about what lead lengths should be used and how much solder should be used to attach the components.

At microwave frequencies, (even low ones) these variations lead to inconsistent circuit performance.

With SMD, the options for lead lengths are removed and soldering variations are lessened leading to more consistent circuit performance.

Is SMD hard to use? I hear this criticism of SMD often, because the components are smaller than leaded parts (only a little smaller in some cases), many people believe that it is difficult to use. If you have normal eyesight, you should have no trouble with 1206 and 0805 sized SMD. If like me you have lousy eyesight, a small eyeglass or magnifier.... maybe a *helping hands* one will even the odds.

One thing is for sure, **every person** I've talked to who didn't like the idea of using SMD had **never actually tried using it for themselves**. Don't listen to the rumours and stories about SMD. Try it for yourself and make up your own mind. Personally, I hate leaded components as I think **they** are hard to

use. To be truthful, I had more problems identifying the markings on the small wire ended resistors used in the kit than with any of the SMD components (supplied in clearly labelled self-seal bags).

Testing Testing!

I've done some terrible things to this kit. I've smacked it off the worktable, thrown it on the floor – during my tantrum, precipitated by the ferrite/aluminum core problem, and partly in pursuit of serious testing. I've heated it and then chilled it with a bag of crushed ice that caused a small upward shift in frequency of 2kHz! This oscillator is bombproof and it is as tough as old boots. I only wish that some of the other designs on the market were half as good as this one.

The Verdict

Apart from the coil core supplied being of the wrong type and the missing tuning capacitor, I have only good things to say about this kit. The printed circuit board is of superb quality with through-hole plating and comes tinned with a printed-component overlay. What more could anyone want. The components supplied are of excellent quality and the only additional items required are a suitable crystal and an enclosure. The omission of the tuning capacitor was for me a minor inconvenience but for a beginner, finding a suitable replacement could be a bit of a problem. Likewise the supplied aluminium coil core which caused me so much head scratching and tantrum throwing.

The supplied paperwork was obviously photocopied from some previously photocopied material - some of the text was virtually unreadable. On the plus side, the inclusion of a layout diagram showing the degree of mesh of the various trimmers was a good touch. My experience (noted earlier) with VC5/6/7 would have been avoided had I bothered to read the notes!

The notes supplied on how to wind the buffer/doubler stage coils were really too cryptic for beginners.

What would you make of : **L4/5 : 1 ½ turn 0.7mm wire 4mm former – opposing senses**

To be fair, there was a small drawing of the desired coil but the quality was terrible. Below that there was a line that may have said – (clockwise – anticlockwise)

It **may** have said that but I'd be guessing. It was really too faint to read.

For a beginner, this sort of instruction is inadequate. Maybe this kit is not aimed at beginners. That's a pity – we all have to start somewhere and new beginners are what we need in our hobby.

Of course, I hadn't read **any** of this when I built the kit -but my coils worked fine anyway. I just *guesstimated* and got on with it!

Hot Rocks ..The Higher Frequency Bands

Although this local oscillator is designed to work in the 1.0-1.3 GHz frequency range, it makes a good driver for further multiplication to the higher frequency microwave bands. If you plan to use this source to feed further multiplier stages, in this way, you may want to add a MURATA crystal heater. These are available from a number of sources and take the form of a simple metal spring clip that fits over your crystal. Bonded on to the clip is a wire ended disc type thermistor that should be connected to a 12-13.8V supply. This acts as a miniature crystal oven, the idea being to keep the crystal at a constant temperature to minimise frequency drift. If you intend to use the oscillator as a driving source for an additional frequency multiplier chain then these devices come highly recommended. Remember, any errors in the oscillator frequency are multiplied by 12 at the output connector. Add more multiplier stages and the errors can become unacceptable. Keeping the crystal at a constant temperature eliminates or greatly reduces the potential for thermally induced drift. There is ample space around the crystal to fit one of these useful devices. If you plan to use one of these heaters, let your crystal manufacturer know when you place your order.

Finals

Do I like this kit? The answer, unreservedly yes! I love it! It is big and uncluttered, easy to build, inexpensive - well under \$60, tough as old boots and I'd recommend it thoroughly. As for criticisms, improve the instructions so that beginners don't have to guess what the coils should look like, supply the correct coil core, oh, and don't forget to pack VC11. Radio Shack doesn't stock them. Some enameled wire and a small quantity of tinned wire for the coils and chokes would also not go amiss. A description of what constitutes a turn (one pass through the core) for the ferrite

bead chokes might also have been helpful to beginners.

I learned about this kit from LA2QAA and I bought mine on his recommendation. After hearing of how tough and stable it was, I thought it would be good to buy one of these kits for use as a test source for work on 23cm. If you need a reasonably priced source for 23cm, this one is hard to beat.

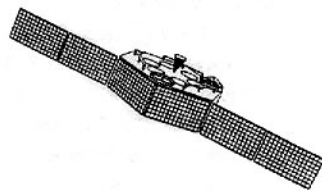
This is quite an old kit design - the drawings are dated 1987. I don't care. It does the job inexpensively and well. Even adding the cost of a crystal and some PCB offcuts for the case shouldn't put the total construction cost much above thirty pounds (~\$50). Are microwaves expensive? Decide for yourself.

LMW Electronics Ltd., a UK company, can be reached at amateursales@lmw.co.uk. An online catalog is available at www.pacsat.demon.co.uk/lmw.htm.

Happy Constructing!

A Small Aside for the 'Techies'

If like me you regularly produce PCB's, take a trip to your dentist and ask if he has any old tools lying around. Most dentists just throw them in a drawer when they get blunt. Dentist's tools are diamond tipped and even blunt tools when used correctly (at high speed – in a Dremel® tool or similar) cut through fibreglass PCB like it was margarine! The tools are diamond-coated with short shanks and even the 'blunt' variety are more than a match for PCB. The useful ones are the tapered sort (basically a tapered diamond tipped rotary file)...useful for cutting slots for 'coffin' capacitors. The ball ended ones are useful for doing countersunk holes for component leads and for removing and unwanted copper. ■



Please Support Phase 3D!

Field Ops Update: Recognition

Barry A. Baines, WD4ASW (wd4asw@amsat.org)

The annual AMSAT Symposium provides a unique opportunity for Field Operations personnel to get together to celebrate successes and share ideas. We also highlight significant achievements of the past year at the Banquet. Not everyone is able to attend the Symposium, so I will use this issue's Field Ops column to share some of the success stories concerning Field Operations that were exchanged during the weekend.

First, a word of thanks to Duane (KO6BT) and Jean (KC6QHT) Naugle for a masterful job of organizing and managing the myriad of details that surrounded the Symposium. They were able to arrange a great location for the Sunday morning Field Ops breakfast that included a buffet in the meeting room for the 28 volunteers who attended. Besides working around the clock taking care of Symposium issues, they spent the weekend prior to the Symposium running the AMSAT booth at the ARRL Southwest Division Convention in Long Beach. People interested in obtaining AMSAT information and materials overwhelmed them. AMSAT-NA was able to obtain about a dozen Arrow Antennas that were available at Long Beach. These were very popular at both Long Beach and the AMSAT Symposium.

Field Ops Recognition

Certainly one of the highlights of Symposium is the Saturday evening banquet and the recognition of outstanding performance by our volunteers during the preceding 12 months. Below are listed the recipients along with wording on their citation:

- **Steve Thompson, W5PK:** For your creation of the Phase 3D model kit as a fund raising device for the Phase 3D project. Your detailed paper model kit not only increased interest in the Phase 3D project, but is a great vehicle for generating additional donations to the project as well. Your initiative in creating this project coupled with your enthusiasm for publicizing the availability of the kit for a suitable donation at the Dayton Hamvention as well as periodic e-mail announcements is deeply appreciated.
- **Frank Bauer, KA3HDO:** For your leadership in organizing the AMSAT 30th Anniversary celebration, which was held at the Goddard Space Flight Center on March 13, 1999. The day was a resounding suc-

cess as AMSAT members were provided tours of the facility, attended an AMSAT-DC meeting in the Visitor's Center, enjoyed an outstanding dinner at the Recreation Dinner, and benefited from a wonderful presentation of the early years of AMSAT. Your willingness to coordinate this effort is certainly appreciated.

- **Bob Carpenter, W3OTC:** For your participation in the AMSAT 30th Anniversary celebration, which was held at the Goddard Space Flight Center on March 13, 1999. Your assistance with the Dinner and other activities associated with the day's activities helped to make for an unforgettable day.
- **Doug Quagliana, KA2UPW:** For your creation of the *Fly Your QSL* CD-ROM. Your efforts to encourage donations to the Phase 3D Satellite Fund by having amateurs submit their QSL card to be scanned onto a CD-ROM was a very imaginative and popular device to increase Phase 3D fundraising. You not only developed the idea but also took the initiative to coordinate the publicity, perform the scanning, and create the CD-ROM. Your willingness to devote your personal time and effort to this successful project is gratefully acknowledged.
- **Dee Interdonato, NB2F:** For continued outstanding support of Field Operations. Your efforts this past year included representation of AMSAT at three different hamfests as well as assisting at the Dayton Hamvention. You also designed a patch to commemorate AMSAT's 30th Anniversary when designs were requested to help recognize this significant milestone for AMSAT. Your interest in helping newcomers with getting started with Amateur Radio satellites resulted in your drafting an overview of satellite operations ("Hamsat Primer"). All of these actions reflect your deep interest in AMSAT and your continued willingness to 'go the extra mile' for AMSAT's behalf.

Certainly the outstanding contributions of these individuals deserve recognition and we celebrate their successes. Their efforts also provide excellent examples of contributing their individual skills and interests in ways that make a real difference for AMSAT. These volunteers helped to educate new satellite users, developed several imaginative ways to encourage contributions to the Phase 3D program, and created a great way to celebrate AMSAT's 30th Anniversary. Again, many thanks to our award winners for their efforts. We also realize that other

AMSAT members have made contributions to AMSAT that were not specifically recognized this year. Without the contributions of all of our Field Operations volunteers, AMSAT would not be as successful as we have been.

Field Ops Breakfast

The Field Ops Breakfast on Sunday morning has become an annual Symposium event. Besides providing a wonderful opportunity to meet fellow area coordinators and encourage additional people to serve as Area Coordinators, the Breakfast also is an exchange of ideas, successes, and encouragement for our volunteers.

During this year's Breakfast a common theme developed during the course of our discussions: "Education" on a number of levels. By this we mean creating awareness and interest in amateur satellite communications by both amateurs and non-amateurs. These areas included:

Education Liaison

A number of area coordinators discussed their participation in local education activities that linked amateur satellite communications with their local schools. Besides past experiences with SAREX and MIREX, we heard about efforts being made to encourage teaching of space sciences and having students use what they have learned to track satellites and participate in amateur satellite communications. A key factor is the developing the points of contacts with local science teachers and schools and making them aware of how they can use Amateur Radio in the classroom. Ken Chafee, WA1QXR spoke about his experiences assisting at the ARRL booth at the annual convention of the National Science Teachers Association. During the discussion Ken explained his role in making science teachers aware of the potential benefits on using Amateur Radio in the classroom as well as highlights AMSAT activities and provides local points of contact.

While not specifically mentioned at San Diego, an excellent example of this approach are the efforts of AMSAT Area Coordinator Pete Hurd, N1SS in the establishment of an Aerospace Science Lab in Houlton, ME.

Using donated funds, volunteers at the Greater Houlton Christian Academy (GHCA) started the laboratory in 1997 for K-12 students which supports math and physical science educational projects related to aviation, meteorology, telecommunications, space technology and related areas. Using his knowledge of Amateur Radio satellite communications and interest in space sciences, Pete serves as a volunteer instructor and GHCA principal researcher for aerospace applications within the Academy. He advised in the purchase of appropriate equipment to create the lab's Amateur Radio satellite and HF station, built the station, and recruited volunteers to help with training classes and related school projects.

A spin-off of these discussions was the suggestion that local AMSAT members contact local astronomical societies and determine if there would be local interest in exchanging ideas and information.

Education was certainly highlighted at this year's Symposium when a conference with

various Universities was held on Thursday, October 7, 1999. The conference was coordinated by Steve Bible, N7HPR, AMSAT's VP for Educational Liaison and attended by AMSAT officials and representatives from several universities. The conference provided an opportunity for both the universities to learn about Amateur Radio as a potential resource and for AMSAT to develop an understanding of the types of small satellite projects under development that may include Amateur Radio. Symposium attendees on Friday and Saturday were provided overviews of several university projects, such as JAWSAT, ASUSat1, and Opal that are expected to be launched later this year.

Information Resources

Area Coordinators can utilize a number of resources to enhance their ability to inform amateurs of the latest information. ARRL Audio News, the weekly Houston AMSAT Net on Tuesday nights (available via satellite or the Internet using Real Audio), and the

Sunday afternoon AMSAT net (14.282 MHz) are excellent sources. There are a number of Local AMSAT nets on VHF/UHF meters that rebroadcast the Houston AMSAT net. For example, I recently received a note from Area Coordinator Dick Tyler, WA2EHL stating that his repeater (447.925 MHz) which covers the Philadelphia area broadcasts the Houston Net and ARRL Audio News on Tuesday evening as well as the "WA2EHL Ham Radio News Report" each Sunday night at 20:30 local.

At this year's breakfast an 'Area Coordinator's Toolkit' was distributed. This is our first step to develop materials to our Area Coordinators to help them serve as 'Ambassadors of AMSAT more effectively. The floppy disk included an Area Coordinator Overview, Area Coordinator Listing, and various presentation materials in Power Point format from Roy Welch, W0SL; Steve Park, W4OEP, and Barry Baines, WD4ASW. The presentation materials ranged from beginner's overview of amateur satellites to satellite tracking and discussion of Phase 3D. KC6ROL also provided information pertaining to ARISS web sources.

Demonstrations

AO-27 is an excellent resource to demonstrate satellites using dual-band radios during daylight. However, club meetings are usually at night, so several area coordinators suggested using the Fuji Satellites utilizing an all-mode 2m/435 MHz transceiver, coax, and Arrow Antenna mounted on a camera tripod.

Serving as Elmers

Consider serving as an Elmer to a newcomer. The opportunity to serve one-on-one with someone who is unfamiliar with amateur satellites is a great way to encourage people to become interested in satellites. Alternatively, try to take advantage of visual sightings of space objects, such as a *Mir*, 'Iridium Flashes', and Shuttle missions as a way to allow people to experience the excitement of space program.

The bottom line is that all AMSAT members have an opportunity to make a meaningful impact on the satellite program by taking an active part in helping others to learn about satellites at all levels. ■

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Phase 3D Watch

[via AMSAT News Service] Both AMSAT-DL and the ARRL reported that Phase 3D Project Leader Dr. Karl Meinzer, DJ4ZC, and a delegation from AMSAT-DL were at the Phase 3D Integration Laboratory in Orlando in October to give the Phase 3D satellite a final once-over.

AMSAT-NA President Keith Baker, KB1SF, tells ANS that "so far, everything is proceeding smoothly." KB1SF said the German team is putting Phase 3D through its paces as a final checkout prior to shipping the satellite to the launch site at Kourou in French Guiana in November.

As ANS has reported a launch contract accepting Phase 3D as a payload for the first suitable Arianespace Ariane 5 launch vehicle was signed October 5th. In a news release last week, Arianespace noted that Phase 3D would be "one of the first secondary payloads boosted by Ariane 5, which will use a special

adapter for orbital injection." The Arianespace release also said that Phase 3D, which weighs 1430 pounds, will be injected into a geostationary transfer orbit (GTO). Phase 3D will then use its own propulsion system to reach an elliptical orbit ranging from approximately 2,480 miles to more than 27,000 miles from Earth. Once in its intended orbit, Phase 3D will have an estimated life span of 10 years.

AO-16/LO-19 are Fully Operational as the On-orbit Element in TRAKnet

Bob Bruninga, WB4APR reports that AO-16 and LO-19 can be used worldwide for mobile satellite position/status and message reporting. TRAKnet links these packets into the worldwide APRServe system for access anywhere via WEB pages for Internet users and APRS users on RF. Recently, a week-long test using the satellites was completed. WB4APR now invites others to join in as the APRServe system grows. Details from WB4APR on using these satellites for APRS are:

- **Mobiles:** Any mobile with a 2m FM radio and Manchester TNC can uplink their GPS position/Status and/or Messages from anywhere. (Although any Satellite TNC/Modem can be used, 99% of most mobile operators would be left out. However, any TAPR-2 TNC CLONE can generate Manchester with the simple addition of an 89 cent XOR gate and a switch. Thus, almost anyone can transmit from his mobile 2m FM rig. For complete details see TRAKNET.TXT in any of the APRSdos docs, *The AMSAT Journal*, or visit <http://web.usna.navy.mil/~bruninga/traknet.html>.)
- **Users:** Anyone can view these packets live by telnet to APRServe at 199.227.86.221 port 23. Or you can view these mobiles by visiting any of the many APRS WEB pages (position display only <http://www.aprs.net>). Or, if any of these Mobiles send you a message, and you are on the air live on your local APRS frequency, then you will receive the packet live via your local IGate.

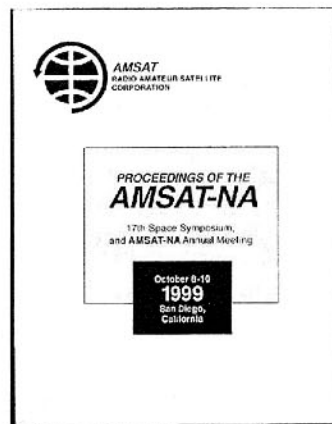
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PROCEEDINGS OF THE AMSAT-NA 17th Space Symposium and AMSAT Annual Meeting

Held October 8 - 10, 1999 in San Diego, California

A partial listing of the contents includes the following papers:

- * The Apogee at Constant Time of Day Equatorial (ACE) Orbit for Amateur Radio Satellites
by Ken Ernandes N2WWD
- * Amateur Radio On-Board the International Space Station
by Will Marchant KC6ROL and Frank Bauer KA3HDO
- * Converting Surplus Qualcomm OmniTrack Microwave Assemblies for Use with Amateur Satellites
by Kerry Banke N6IZW
- * AMSAT Builders Channel for HT and Mobile Satellite Communications
by Bob Bruninga WB4APR



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AMSAT Jewelry Contest Coordinators Leanore and Dave Guimont. (photo by Art Feller, W4ART)

- **Satgates:** What makes all this possible is Mac/WinAPRS or APRS+SA software. Any conventional user of these popular APRS programs can simply dial into his ISP, and any packets his station sees on RF are automatically forwarded into the worldwide APRServe system. If such a user just happens to dial in to his ISP during a pass and is using a PACSAT TNC and is working an AO16 or LO19 pass, then he automatically and without any effort serves as the Sat-Gate for his entire footprint.
- **Downlink:** Although the downlink is primarily needed only at the Sat-Gate stations, any mobile with an all-mode UHF rig or HF rig and downconverter can also receive the downlink. Of course a small beam will always be necessary due to the weak downlink signal from the satellite. (Conversely the 2m uplink works fine on an omni-directional antenna).
- **Group Effort:** The reason for this posting is to invite anyone with a 1200 baud PSK PACSAT TNC to come join us. We need enough people playing on the bird so that we can guarantee that there will always be at least one station somewhere on the East and West coast of the USA listening to the downlink.

When Traknet was first proposed over two years ago, we were asking for special software, unattended and automatic SatGates involving a lot of complexity and critical paths. But since most versions of APRS now have built-in RF=TNC=ISP interfaces to the Internet, now *any* station can serve at any time as a SatGate. So, as long as at least one person in the satellite footprint is receiving the satellite, then *everyone* has access to the live downlink via APRServe!

Note, the total ISP time is only about 15 minutes per pass, so a simple dial-up ground station is just fine. There is no need for permanent dedicated Internet access.

- **Future:** Now, if this mode becomes popular, then it will also be easy for someone to write a PSK demod and Manchester Modem for using *any PC* and a *sound card*! Then anyone anywhere can do this.

If you have not experienced the old-fashioned fun of live, person-to-person UI packet digipeating (such as became popular via *Mir* over the last year or so), then dust off that old PSK modem and join us on AO-16 and LO-19.

24 Passes a Day: Also, if we could get IO26 to enable digipeat, then we would have a constellation of *three Traknet satellites* giving as many as 18 passes a day. The ultimate addition to this constellation would be if all three satellites would enable a COMMON ALIAS so that the mobiles didn't need to change DIGIPEATER calls on every pass. An ALIAS of TRKNET for example would do nicely. If WO-18 could be re-activated, then we could have 24 passes a day!

All *four* of these satellites have a common UPLINK on 145.90 MHz! Thus the mobile does not need to QSY, nor change his DIGI PATH! You just concentrate on driving and we can track you.

If you are interested in this use of AO-16/LO-19, join the AO16APRS SIG by subscribing with listserv@tapr.org.

Results of the 7th Annual AMSAT Jewelry Contest

[via WB6LLO] Leanore and I would like to thank all of the entrants in this year's contest. The spirit in which it is accepted is magnificent, and we sincerely hope it is as much fun for you as it is for us. We were fortunate to have the convention here in San Diego, and of course we look forward to next year in Maine!

With the latter in mind, any and all suggestions for the Eighth Contest to be held at the next AMSAT Symposium in Maine will be accepted gratefully!

The total number of entries, 80, came by amateur satellites, e-mail and telephone, with most of them hand delivered at the convention or ham clubs in the area. The winner, Eddie Pettis, N5JGK, of Vicksburg, Mississippi who came within .0018261 MHz of the *correct* frequency of 435.8531739 MHz!

Duane Naugle, KO6BT of San Diego, California was second, and Anthony Monteiro, AA2TX, of North Andover, Massachusetts came in third.

No, none of the winners made contact using the antenna, but three participants attending the convention did make contact. Tnx agn. 73 Dave Guimont, WB6LLO

AO-27 on a Shoestring

Ray Soifer, W2RS reports that after reading (and writing as well) that one cannot work AO-27 with the rubber duck antenna that comes with handheld transceivers. W2RS provides the following summary on his recent experiment with AO-27.

This morning, there was an overhead pass (90 degrees maximum elevation) with relatively light satellite usage because it was a weekday. I got on AO-27 with my FT-50R handheld, a 2-watt battery instead of the

5-watt battery that I normally use, and the standard-issue 7-inch (18 mm) rubber duck antenna. My estimated EIRP was approximately one-half watt. The only concession I made to common sense was to use a speaker-mike so I could move the radio around more freely to follow the bird than if I had to speak and listen without it.

The results: I worked four stations: NR3G, VA3JDH, KA0OXY and WA2HKS/mobile.

Admittedly, this experiment was conducted under ideal conditions and after many, many failed attempts when conditions were less than perfect. I would not recommend this to others (or even to myself) as a normal mode of operation. On the next pass, I went back to my 5-watt battery and MFJ-1717.

On the other hand, I learned a lesson: never ever say that something won't work. You can make QSOs on AO-27 with a 2-watt HT and a rubber duck. Just not many of them and not very often!

IARU Administrative Council Meets in Norway

[via the AMSAT News Service] The ARRL Letter recently contained a report about an IARU meeting in Norway that will be of special interest to satellite operators. According to the ARRL, the International Amateur Radio Union Administrative Council has adopted an information paper for prospective owners and operators of amateur satellites.

The Council said the document's purpose is "to reduce the possibility of inappropriate use of the Amateur-Satellite Service." The action came as the Council convened for the first time under the chairmanship of IARU President Larry Price, W4RA.

The information paper - developed and adapted from material originally prepared by AMSAT-NA - cautions that the Amateur-Satellite Service is not intended for broadcasting; that communication must be in plain language, and access must remain open to all amateur licensees.

IARU Secretary David Sumner, K1ZZ, said that while last April's Swatch 'Beatnik' satellite situation did not prompt the adoption of the information paper, that type of proposed use would be an example of an inappropriate use.

Last April, Swatch Watch announced plans to use a mini-satellite operating on 2-meters to transmit messages related to its campaign to establish the 'Swatch Beat' as a new global concept of time. Amateurs protested the Swatch plans because of the commercial connection, and the project was scrapped.

W2VU To Be New Editor of CQ

Hicksville, NY, September 8, 1999 - CQ Communications, Inc. President Dick Ross, K2MGA, announced today that Richard Moseson, W2VU has been named the new editor of *CQ Magazine*, effective September 1, 1999. The appointment comes six weeks after the death of long-time *CQ* Editor Alan M. Dorhoffer, K2EEK, who held the position for 23 years.

Since joining CQ Communications, Inc. seven and one half years ago, Moseson has been involved in numerous innovative projects, including the creation of *CQ*'s award winning series of Amateur Radio video tapes, the management of *CQ*'s highly-acclaimed 50th Anniversary issue, the development of *CQ*'s various web sites, and most recently the launch of *CQ VHF Magazine* in 1996. He is the founding and current Editor of *CQ VHF*, and will continue in that role in addition to his new duties as Editor of *CQ*.

Gail Schieber, KC2DHK, *CQ*'s long-time Managing Editor, will continue in the position she has held for 20 years.

Those who know Rich know him to be an avid Amateur Radio operator and a highly-skilled editor dedicated to delivering the best possible product to his readers. Rich has a very strong commitment to making *CQ* even better than it has been in the past, and comes well equipped to fulfill that commitment.

Rich holds an Extra Class Amateur Radio license, and has been licensed since 1970. He is active on a variety of modes and bands on HF, VHF, and UHF.

Asked what he sees as the future of *CQ* under his leadership, Rich observed, "*CQ* has a long and highly regarded history in Amateur Radio, and is a fine publication exactly as it is. Every editor has different views towards the various components of his publication, and I'm no different, but what I have the privilege of inheriting is a solid magazine. Do I envision making changes? Of course, but

changes intended to make an already good magazine even better. One immediate change is that we will be actively soliciting feature articles on all aspects of Amateur radio from all segments of the Amateur community." Article proposals may be sent by e-mail to CQ@CQ-Amateur-Radio.com, or by postal mail to *CQ*, 25 Newbridge Road, Hicksville, NY 11801.

Hams Sought to Assist Avian Researchers

[via AMSAT News Service] Wondering what to do with your satellite gear between passes of your favorite bird? If you live in the central U.S. —from North Dakota to Texas— and can receive signals on 172 MHz, wildlife researchers need your help.

For the second year, hams are helping to track the movements of endangered burrowing owls as they migrate southward from Canada. Scientists think that they fly all the way from Saskatchewan and Alberta to southern Texas and northern Mexico, but accurate data is scarce and difficult to obtain.

The owls are on the move again, heading south for the winter.

Biologists are asking for help from hams to track some newly tagged juvenile birds. "Perhaps this fall will bring the first recorded sighting in the U.S. of a live Canadian-banded burrowing owl, and perhaps a ham will make it happen," said ARRL Amateur Radio Direction Finding Coordinator Joe Moell, K0OV.

Since the birds remain in or near underground burrows during the day, monitors are most likely to copy the short-pulsed signals during hours of darkness, when the birds are migrating and foraging.

K0OV tells ANS that all the equipment needed is a scanner or an extended-range hand-held plus an outside antenna. Even better is direction-finding gear for 172 MHz. The equipment found in the average satellite hamshack would be ideal.

For more information, check the burrowing owl web page at: <http://members.aol.com/homingin/>

The page contains the exact frequencies of all 48 tag transmitters plus photos, information on the expected migration path, and

suggestions for simple monitoring and tracking gear.

Goddard Anniversary

AMSAT's Dan Schultz, N8FGV, told ANS about a recent anniversary that helped to form the groundwork for space launch vehicles as we know them today.

On October 19, 1899, then 17-year old Robert Goddard climbed a cherry tree in the backyard of his family's home in Worcester, Massachusetts. In later years he wrote about that fateful day:

"This was the situation when, on the afternoon of October 19, 1899, I climbed a tall cherry tree at the back of the barn, on a plot where I had visions of some kind of frog-hatching experiments, and, armed with a saw which I still have, and a hatchet, started to trim the dead limbs from the cherry tree. It was one of the quiet, colorful afternoons of sheer beauty which we have in October in New England, and as I looked toward the fields at the east, I imagined how wonderful it would be to make some device which had even the possibility of ascending to Mars, and how it would look on a small scale, if sent up from the meadow at my feet. I have several photographs of the tree, taken since, with the little ladder I made to climb it, leaning against it. It seemed to me then that a weight whirling around a horizontal shaft, moving more rapidly above than below, could furnish lift by virtue of the greater centrifugal force at the top of the path. In any event, I was a

different boy when I descended the tree from when I ascended, for existence at last seemed very purposive."

This date was of such significance to Dr. Goddard that he thereafter referred to it as his "anniversary day" and almost every year made some reference to it in his diary as his personal holiday.

On the 100-year anniversary of that day and with a U.S. spacecraft (Mars Polar Lander) approaching Mars for a landing along with the recent announcement of the upcoming launch of Phase 3D, it seems fitting to reflect on the vision of Dr. Goddard so many years before — in the branches of a cherry tree one October afternoon.

ARRL Task Force Seeks Future Technology Proposals

The ARRL Technology Task Force wants to hear from hams with ideas and proposals for new technology to carry Amateur Radio into the next century. The ARRL Board of Directors created the Task Force and the companion Technology Working Group last January, and ARRL President Rod Stafford, W6ROD, has appointed a number of leading amateurs to serve on both panels. The Task Force and the Working Group will work hand-in-hand to identify, evaluate, and promote the most promising 21st Century technologies for Amateur Radio.

The Task Force consists of members of the ARRL Board family and the Headquarters

staff. Chairing the Task Force is ARRL First Vice President Steve Mendelsohn, W2ML. Other TTF members are Roanoke Vice Director Dennis Bodson, W4PWF; Hudson Director Frank Fallon, N2FF; New England Director Tom Frenaye, K1KI; Southwestern Vice Director Art Goddard, W6XD; Pacific Director-elect (and current Vice Director) Jim Maxwell, W6CF; International Affairs Vice President Larry Price, W4RA; and Rocky Mountain Director Walt Stinson, W0CP.

The Technology Working Group will evaluate technical proposals and make recommendations to the Technology Task Force, which, in turn, will make specific policy proposals to the ARRL Board of Directors.

The Working group is an expert panel selected from among League members representing a broad spectrum of Amateur Radio interests and activities. Chairing the Working Group is CQ Editor Rich Moseson, W2VU. Other members are AMSAT-NA President Keith Baker, KB1SF; Peter Coffee, AC6EN; Mike Cook, AF9Y; Gene McGahey, NR0NR; ARRL Technical Relations Manager Paul Rinaldo, W4RI; Dennis Silage, K3DS, and QEX Editor Doug Smith, KF6DX.

ARRL Laboratory Supervisor Ed Hare, W1RFI, will serve as ARRL HQ staff liaison to both committees.

The Task Force invites information and concepts on a wide range of technologies with the potential to improve Amateur Radio and to promote what the FCC calls "continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art." The Task Force invites the submission of ideas and proposals from all parts of the amateur community, and will use the input to help formulate League policy recommendations on a wide range of technical issues.

Amateurs are invited to complete the form on ARRLWeb at <http://www.arrl.org/news/ttf/>, send e-mail to the Task Force at tfinput@arrl.org, or offer your ideas by mail to the ARRL Technology Task Force, c/o Ed Hare, W1RFI, 225 Main St, Newington, CT 06111. Suggestions are requested by November 30, 1999. ■



AMSAT San Diego Symposium organizers Duane (KO6BT) and Jean (KC6QHT) accepting thanks for a job well done. (photo by Art Feller, W4ART)

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5.0 kg

FEATURES

- **Continuously Adjustable TX Power**
 - More control
 - Extends satellite life by using minimum power
- **Independent Main / Sub Band Rx**
 - Tuning, AF and squelch level, and 4 function control switches per band
 - In Satellite mode, Sub is uplink, Main is downlink
 - IF shift for either Main/Sub band
- **9600 or 1200 BPS Packet Capable**
 - Direct audio modulation
 - Excellent C/N ratio
 - Excellent frequency stability
 - Adjustable ACC modulation signal levels
- **High Frequency Stability**
 - ± 3 ppm standard; ± 0.5 ppm optional
- **100% Duty Cycle**
- **AF Speech Compressor** for increased average talk power
- **Auto Repeater** with one-touch repeater functions
 - Built-In RIT Function
 - Built-In Electronic Keyer
 - RF Attenuator
 - Noise Blanker
 - Tone Encoder (CTCSS)
 - Separate Speaker Jacks
 - 1 jack per band
 - AGC Time Constant Control
 - Auto Repeater Function
 - Rugged ICOM Construction
 - Built-In CI-V Port
 - 2 Optional CW Narrow Filters

A FEW NOTES FROM THE QST EXPERTS:

"(The IC-821H) is a terrific dual-band multimode transceiver for all applications. Not only is the IC-821H an excellent VHF/UHF weak signal or contest radio, it is the cornerstone of a high performance satellite station (digital or analog). Hams who have the Phase 3D satellite in mind will want to give serious consideration to the IC-821H. It also offers superb FM-voice and 9600-baud packet performance. Combine all of these features with the IC-821H's go-anywhere size and you have a radio that's ideal for almost any application above 144 MHz!"

— QST Magazine, 3/97

For REAL satellite performance, there's only one rig to seriously consider...the IC-821H. Contact your authorized dealer today, or call for a free brochure:
425-450-6088

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www.icomamerica.com